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THE
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THE PURCHASE OF FOREIGN MACHINERY.

IT is to some extent the fashion among a certain section of the engineering profession to assume that the purchase of machinery from abroad for use in the electrical industry in this country and in our Colonies, is at this present time not only excusable, but, in fact, quite unavoidable.

It is contended that manufactures which have been made in this country for years past cannot be obtained in the necessary time and at the same cost as they can from abroad, whilst in the case of newer types of machinery, such as polyphase generators, the more limited experience of our manufacturers in making this class of apparatus is considered sufficient reason for allowing our capital to flow into the hands of foreign manufacturers. In the present article we propose to show that a good deal more is made of these points than is actually necessary, and that a little more consideration on the part of purchasers, or their professional advisers, would enable many of the orders at present going abroad to remain in the country.

The difficulty, so often put forward, of obtaining delivery within the required time, can be dismissed in a few words. Certainly machines cannot at present be supplied from stock from workshops in this country, excepting in the smaller sizes, but is it too much to expect that, in ordering, a little foresight be exercised to enable the work to remain in the country?

In some cases this is, of course, impossible, but is it not a fact that a strong tendency exists among purchasers to defer ordering until the last moment, in the knowledge that, if necessary, delivery can be obtained from stock, by going abroad? If purchasers gave a little thought to this point, one of the chief causes for allowing work to go out of the country would be removed.

Electrical manufacturing firms in this country are extending their works gradually. The past year or two has seen many steps taken in this direction, not only in extending existing shops, but in many cases, in moving from unsuitable localities to more favourable ones. Those of us who may feel inclined to wish that this increased manufacturing capacity might become available rather more quickly, must not overlook the fact that electrical manufacturers in England have had a hard fight in the past, and now that better days seem at hand cautious tactics must be adopted.

The electrical industry here cannot afford to run any risks of losing the confidence of the investor, and only a few failures are necessary to hinder and delay further progress for many years.

The next point which we propose to touch on is the question whether foreign manufacturers are really in a position to manufacture cheaper, and to sell in this country at a lower price than our manufacturers can afford to do, as it appears that many orders are at present going abroad in this belief.

the shaft is rotated in, say, the clockwise direction, as the shaft engages a lug on the sleeve, and the other sleeve being retained by the drum, winds up the spring. The arm of the cam then moves a roller on a

arrangement, the meter registers the difference of the effects of the coils, A, B, on the pendulums, and the coil, D, increases both these effects. 4 claims.

We are inclined to think that this is not the case, but that the difference in the objects for which we manufacture, accounts to a large extent for this discrepancy in price. Whilst our methods of working have hitherto demanded machinery of the highest workmanship and substantial design, which will last for many years, American and Continental designers make cost their chief aim by sacrificing life, on the principle that by the time their machines are ready for the scrap heap, something better will have come along.

If found necessary, British manufacturers can very considerably increase the rating of their machines, as it is well known that very liberal margins are allowed in most British-made machines, which are conspicuously absent in most foreign manufactures.

We have much to learn from Continental and American firms: they know how to manufacture in large quantities, and how to sell their manufactures when completed. If they beat us on price, however, assuming fair competition to exist, it is not because they can manufacture cheaper, but that their designs lend themselves to cheaper manufacture.

If the purchasers in this country make up their minds that machines built on these principles will answer their purpose, and that to a certain extent freedom from breakdown, low maintenance costs, and long life, should be sacrificed to first cost, our manufacturers will have to lighten their designs, but until this feeling becomes prevalent, we cannot be called backward in carrying out the traditions of our engineering reputation that the cheapest machine is the one that costs least over a period of many years.

The question of polyphase generators is a more difficult one. That the next few years will call for much machinery of this type cannot be disputed. In the manufacture of this class of machinery we are undoubtedly behind our foreign competitors, but can it be thought, even for a moment, that many of our more prominent manufacturers could not make quite as great a success of it?

At the present time many manufacturers in this country are anxious to make a start in this direction, and here again it is in the power of our consulting engineers to help them towards this object. Specifications calling for only those firms to quote who have previously built similar machines, are too stringent under the circumstances, and can only tend to delay progress in this country still further.

Consulting engineers naturally, for their own reputation, prefer running no risks, but surely names such as Siemens, Crompton, the Electric Construction Company, to mention only a few among those who have hitherto been chiefly associated with continuous current work, and who are anxious, we believe, to include polyphase generators among their standard manufactures, should be a sufficient guarantee to warrant their being entrusted with contracts for which they may tender, provided their price is somewhere near the mark.

If this consideration be not extended to our manufacturers, it will be considerably more difficult for them to make a start in manufacturing polyphase plant, for private enterprise is at a disadvantage in this country, and much of the polyphase plant installed during the next few years will be by Corporations.

Another point in which it would not be difficult to assist our manufacturers in obtaining a footing in the manufacture of polyphase machinery is in the sub-division of contracts, to which we have at other times referred.

It is scarcely surprising that a contract like the one recently placed by the Manchester Corporation, amounting to about £70,000, for polyphase machinery, has had to go abroad, as no individual firm was willing to take the whole responsibility at a sufficiently low figure; but if this contract had been sub-divided, we think it would not have been difficult to obtain favourable offers for certain sections of it from manufacturers in this country.

The sub-division of a contract of this description certainly gives the consulting engineer more trouble, and throws more responsibility on his shoulders.

It is in matters like these that our consulting engineers can either help our industry, or hinder it by introducing such difficulties as, at the present stage, our manufacturers are unable to meet.

Before concluding, we should like to point out that many orders for electrical machinery find their way out of this country, not because of any fault on the part of our manufacturers, but due rather to a position, which we regard as undesirable and unpatriotic, assumed by certain influential persons in our engineering industry, who thereby often hamper fair competition.

We refer to those in the engineering world who see fit to become directors either of new companies, formed with the sole object of acting as agents for foreign manufacturers, or who add a special department to their business in order to represent them.

Firms of foreign origin who commence manufacturing in this country, and form a separate company to carry on these operations, naturally try to get the best and most influential men from among us to act as directors; and no exception can be taken to this, seeing that they spend their money chiefly in this country. It is, however, a totally different matter for those in high positions, who often, by virtue of being directors of many other companies, influence large orders passing out of the country without fair competition, because they happen to be connected with the agents for foreign manufacturers.

We have in mind two different cases. One is that of a well-known firm of general engineers which has added an electrical department, a departure quite outside its own business, which enables it to act as agent for a firm of foreign manufacturers.

Unhappily, from our point of view, these agents are closely connected, both through their chairman and through their ordinary business connection, with many firms, who give them the preference of their orders for electrical machinery.

In the other case a director of one of the largest engineering concerns in this country, who have built up their business largely on Government orders, lends his name and influence to a company formed to act in a precisely similar manner. Here again many orders necessarily go abroad without our manufacturers having a "look in."

We do not wish to imply that there is anything immoral or illegal in all this, but merely to express surprise that those in high positions care to do these things.

It is well known that a powerful director can influence many orders, not only with the other companies with which he may be directly connected, but from his standing in the profession, and these orders are often passed practically without competition.

Under the circumstances, we think that some of these gentlemen might find it more consistent with their other views on trading not to be the means of capital going out of the country in this way.

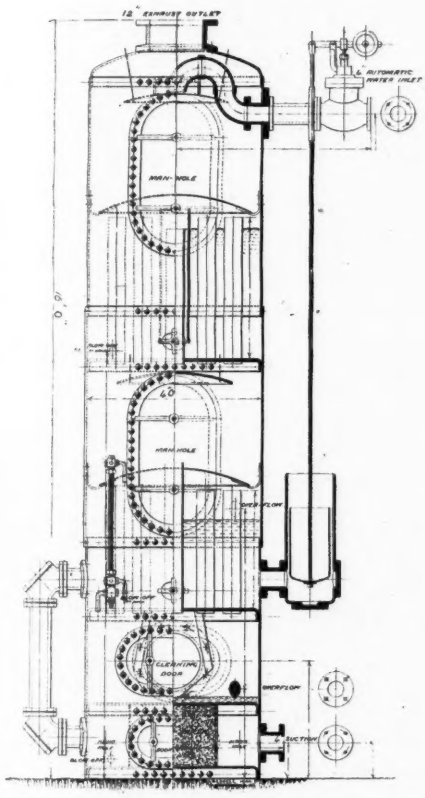
In conclusion, we have tried to point out a few of the cases where we can all assist in keeping as much work as possible in the country and in sending as little as we can abroad.

Manufacturers at home are at present at a disadvantage compared with their large competitors abroad, in so far as the question of delivery is concerned; they have, however, some consolation in feeling that their more cautious tactics have placed them in a sounder financial position than their American and Continental competitors. It is the duty of every Britisher to encourage them, and to enable them to build up as large a manufacturing industry in this country on the soundest financial lines as is possible.

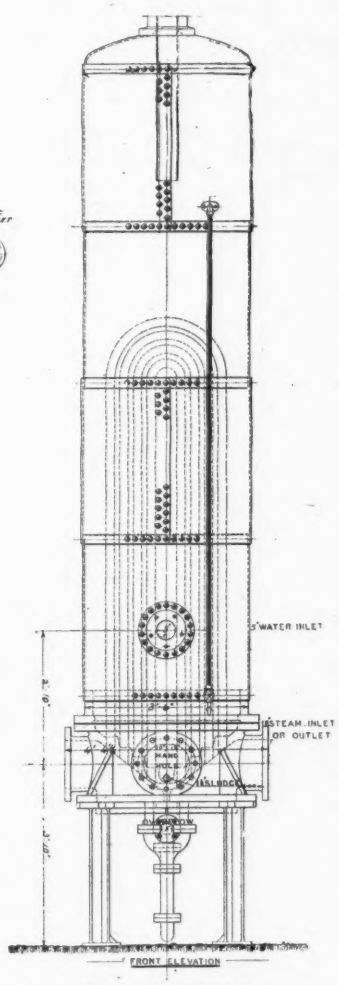
GLASGOW INTERNATIONAL EXHIBITION.

IV.

The remaining exhibits in the boiler house consist of four feed-water heaters and a Green economiser. The heaters were made by Messrs. Joseph Wright & Co., of Tipton; two of them are of the well-known "Berryman" type, standing 19 ft. 6 in. high, with a diameter of 3 ft. 6 in., and the other two are of Messrs. Wright's "Excelsior" pattern, 16 ft. high, and of the same diameter. Nearly 8,000 of the former type have been made, and over 3,000 of the latter. Each heater is intended to heat 2,000 gallons of water per hour to boiling point; the Berryman heaters are designed for a working pressure of 150 lbs. per sq. in., while the Excelsior heaters work at low pressure, and contain filters and oil separators, so that all the condensed steam can be used in the heater in addition to the fresh feed-water.



Duplex Excelsior Patent Heater.



Berryman Heater.

One of the Berryman heaters is provided with the firm's patent siphon bottoms; the other is of the "Tipton" pattern, standing on four legs, with large cleaning doors. The latter, we understand, is becoming the most popular of the four kinds of heater made by Messrs. Wright. The heaters are made specially large, in order to provide a large reserve of hot water for the boilers to draw upon in case of emergency, while the slower motion of the water permits of a greater proportion of the suspended impurities being deposited in the heater. The Excelsior pattern has been adapted to water softening as well as heating.

The construction of the heaters is shown by the drawings which we reproduce. The inlet and outlet steam pipes are 12 in. in diameter, and receive the exhaust steam from some of the main engines in the power department.

The economiser is of Messrs. Green's standard type, with 192 tubes (1,920 sq. ft. heating surface); it is built for a pressure of 200 lbs. per sq. in., and is used for heating the feed water for the Penman Lancashire boilers referred to in our last issue, which provide steam at 120 lbs. per sq. in. for the exhibitors of steam engines outside the power department. The waste gases from these boilers are led into a common flue, through the economiser, and into a wrought-iron chimney 80 ft. high, 6 ft. in diameter. A fan supplied by the Sturtevant Engineering Company, and driven by one of their engines at 450 revolutions per minute, provides an induced draught in connection with this plant. The scrapers are driven by one of Messrs. Green's engines.

Before leaving the boiler house, we must not omit to draw attention to the variety of non-conducting materials employed for covering the boilers and pipes, and forming the exhibit of Messrs. Reid, MacFarlane & Co., Limited, of Glasgow. Asbestos mattresses and galvanised sheet iron in portable sections; the Washington Chemical Company's magnesia; Skye diatomite composition, and diatomite with asbestos fibre; and Turner's asbestos composition, are used for covering the boilers and some of the pipes, while Turner's asbestos rope and mats, and Anderson's webbed silicate and silicate pipe cloth, are used for pipes and flanges. Here is an abundance of choice for the station engineer!

The pump and heater room is situated within the main building of the Machinery Hall adjoining the boiler house, and on the same level. It is, therefore, sunk about 8 ft. below the level of the engine room.

In the pump room are placed two of Messrs. Royles' Class A heaters and two of Class B. The former are steam-fed through 10-in. exhaust inlet branches on the upper part of the heater, the steam circulating as it descends round a number of Row's patent indented tubes, made from solid drawn copper pipe, which form the special feature of this firm's heaters. At the same time the feed-water is forced upwards through the tubes, which, in consequence of their peculiar formation, utilise the heat in the steam to the utmost possible advantage. The heaters are served by two of Messrs. Carruthers' compound vertical duplex pumps, with cylinders 5 in. and 9 in. in diameter, and pumps 5 in. by 10 in. stroke, capable of delivering 35,000 lbs. of feed-water per hour against a pressure of 160 lbs. per sq. in. These pumps are fitted with positive head gear—that is to say, the gear is actuated directly by means of levers from the pump rods.

Feed waters which contain much sediment or chemical impurities should not be passed through tubes, as these, after a short time, become encrusted internally. Messrs. Royles have adapted their Class B heaters to suit these conditions; in this case the mode of working is reversed, the exhaust steam passing through the Row tubes downwards and the feed-water circulating around the tubes in an upward direction, finally passing out to the boilers. This type is amply provided with inspection and cleaning doors, and, like the others, is fitted with relief valves, gauges, drains, &c. A bye-pass is provided, so that the feed may be sent direct to the boilers should the heater be open for repairs or cleaning.

The Class B heaters are worked in conjunction with a set of Messrs. G. & J. Weir's vertical direct-acting feed pumps, with cylinders 9½ in. in diameter, pump 7 in. in diameter, and stroke in each case 21 in.

In the pump room there are also two Worthington vertical direct-acting feed pumps, with cylinders 9 in. and 6 in. × 12 in. stroke, each capable of delivering 35,000 lbs. of water per hour against a pressure of 160 lbs. per sq. in. These are used in connection with Messrs. Wright's heaters in the boiler house.

As we shall have occasion to deal with the various classes of pumps above mentioned at a later date, it is unnecessary at this stage to describe them in detail.

NOTES ON THE THEORY OF SYNCHRONOUS MOTORS AND OF ALTERNATORS IN PARALLEL.

By ALEXANDER RUSSELL, M.A.

(*Concluded from Vol.* 48, *page* 996.)

The Power Factor of a Synchronous Motor.

The power factor of the motor circuit is the cosine of the angle between the current vector O K and the line joining the extremities of the two vector E.M.Fs., O A and O C in fig. 1. A little consideration will show that for certain excitations, O K will be parallel to A C, and hence the power factor will be unity. The explanation of this result is that the assumption that O A, O C, and O K, are in one plane is only strictly true in a very special case. If we make the assumption that it is true, instructive curves can be drawn.

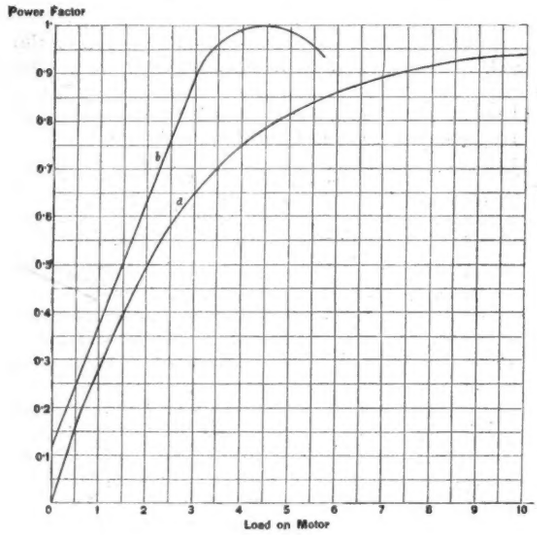


Fig. 8.

In fig. 8 "*a*" shows the relation between power factor and load when γ is 90°, and "*b*" when γ is 45°. In "*a*" the power factor increases with the load and attains its maximum value 0·96 when the load has its maximum value of 120 KW. In "*b*" the power factor is unity when the load is 42 and it then diminishes. The maximum permissible value of the load is now only 56 KW.

Curves Showing how the Power Factor varies with the Excitation of the Motor at different loads.

In fig. 9 the data are the same as for the curves in fig. 6, so that the two sets of curves can be compared. For each curve the power factor equals unity for an excitation represented by 1,000 volts in the diagram, and comparing with fig. 6, we see that the current is a minimum just after the power factor is unity.

Two equal Alternators in Parallel.

The principal assumptions we have to make in order to get a working theory are :—

(1) That the shapes of the E.M.F. waves are such that the current vector is in the same plane as the E.M.F. vectors, and

(2) That each machine is supplying half the external current.

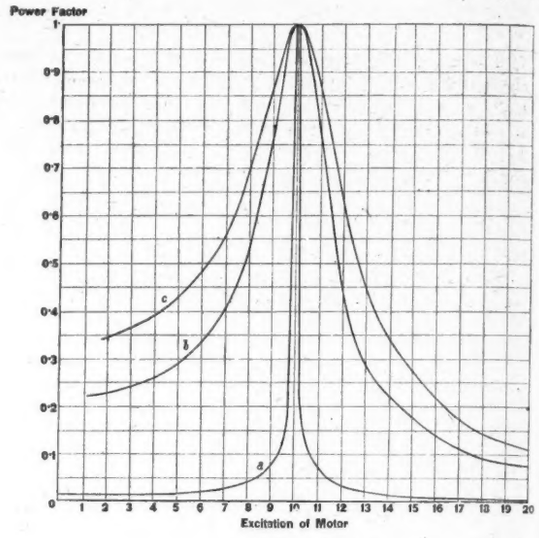


Fig. 9.

If i_1 and i_2 be the instantaneous values of the currents through the armatures, then, since

$$i_1 = \tfrac{1}{2}(i_1 + i_2) + \tfrac{1}{2}(i_1 - i_2)$$

and

$$i_2 = \tfrac{1}{2}(i_1 + i_2) - \tfrac{1}{2}(i_1 - i_2).$$

The second assumption amounts to considering that $\frac{1}{2}(i_1 - i_2)$ is the instantaneous value of the synchronising current. If the self-inductances of each armature were constant, this would be correct. It may, therefore, be regarded as true to a first approximation.

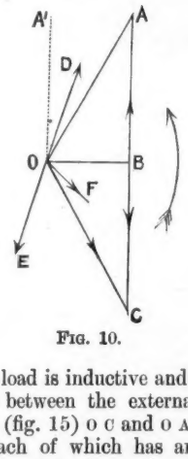


Fig. 10.

Suppose that the load is inductive and that β is the angle of phase difference between the external current and the external P.D. Let (fig. 15) O C and O A represent the two machine E.M.Fs., each of which has an effective value E. Let B be the middle point of A C, then, as formerly, B A or B C (V) will represent the voltage in the external circuit. Let O F represent the synchronising current, and let O D and O E be each half the current in the external circuit ($\frac{1}{2}$ C) which we suppose to lag behind V by an angle β. Let the angles B O A and D O A′ be $\frac{\theta}{2}$ and β respectively, and let W_1 and W_2 be the loads on the machines, whose vector E.M.Fs. are O C and O A. Then since the work done is the product of the apparent watts multiplied by the cosine of the angle of phase difference, it is easy to see from the figure that

$$W_1 = E \cdot \tfrac{1}{2} C \cdot \cos C O E + E \cdot \frac{2 O B}{I} \cdot \cos C O F$$

$$= \tfrac{1}{2} E C \sin\left(\frac{\theta}{2} - \beta\right) + \frac{E^2}{I}\{\cos\gamma + \cos(\theta - \gamma)\} \quad (7)$$

Similarly

$$W_2 = \tfrac{1}{2} E C \sin\left(\frac{\theta}{2} + \beta\right) + \frac{E^2}{I}\{\cos\gamma + \cos(\theta + \gamma)\} \quad (8)$$

It will be seen that when C is zero, these formulæ agree with formulæ (2) and (3) given above.

The difference between the loads on the two machines is given by

$$W_1 - W_2 = - E C \cos \frac{\theta}{2} \sin \beta + 2 \frac{E^2}{I} \sin \theta \sin \gamma.$$

If θ equals π, that is, if the machines are in phase as regards the external circuit, the right hand side equals zero and the load on each machine is the same. For good regulation $W_1 - W_2$ ought to be large when θ is very little less than π. Let θ equal $\pi - x$ where x is small, then substituting for θ we have

$$W_1 - W_2 = \frac{E}{2} \left(\frac{4 E}{I} \sin \gamma - C \sin \beta \right) x \qquad (9)$$

since we may write x for $\sin x$ when x is small.

We see from (9) that when the external circuit is non-inductive, that is, when β is zero, then $W_1 - W_2$ is independent of the load, for

$$W_1 - W_2 = 2 x E^2 \frac{\sin \gamma}{I}. \qquad (10)$$

Hence increasing the excitation E greatly improves the regulation. Also the greater γ is, and the less I, the better the running. It must be carefully noted, however, that γ and I are not independent of one another. It is no use diminishing the impedance if we at the same time diminish γ.

Let $C^2 R$ be the ohmic loss in the circuit of the armatures, and let H be the sum of all the other electrical losses then if E^1 be the driving E.M.F.

$$C^2 R + H = C E^1 \cos \gamma$$

$$\therefore \quad R + \frac{H}{C^2} = I \cos \gamma$$

Hence

$$\frac{\sin \gamma}{I} = \frac{\sin 2 \gamma}{2 I \cos \gamma}$$

$$= \frac{\sin 2 \gamma}{2 \left(R + \frac{H}{C^2} \right)} \qquad (11)$$

If H were zero we see from (11) that $\frac{\sin \gamma}{I}$ would be a maximum when γ is 45°, and in this case I would equal $R \sqrt{2}$. The regulating power would be twice as great when γ is 45°, as it would be if γ were 75°, supposing of course that the resistance of the circuit were the same in the two cases. The smaller this resistance provided γ remained 45° the better would the alternators run in parallel.

We do not think that the shape of the wave has much to do with the regulation. The best shape for the synchronising E.M.F. is the one that will make $\frac{\sin \gamma}{I}$ a maximum. If the machines give a sine wave of E.M.F. the synchronising E.M.F. is a sine wave, I is therefore a minimum, but γ is small. If the machines give rounded or peaky waves, the driving waves are peaky or rounded and I is large, but so also is γ. Exactly how $\frac{\sin \gamma}{I}$ varies with the shape of the wave needs special investigation, but for waves not very different from sine waves it does not vary much.

Again from (9) when the load is very inductive and the current large it is possible for $W_1 - W_2$ to be zero or negative, so that there is no regulation at all, or the machines may even want to run in series. If the external circuit act like a condenser β will be negative, and hence the regulation will be better than for a non-inductive circuit. In this case it can even happen that the regulation improves as the current increases.

Formula (9) seems to point out a possible way of making two alternators run in series. Another way would be to join them in series with a large condenser or an over-excited synchronous motor.

In the above paper we have not considered the mechanical causes that sometimes make parallel running difficult, or the many ingenious electrical devices in use to get over these difficulties. Neither have we considered how armature reaction tends to flatten the wave of E.M.F. with a lagging current, and make it peaky with a leading current, &c. M. Leblanc* proposes to annul armature reaction altogether by having special windings on the field magnets, and such a procedure has much to recommend it. In this paper we have merely considered a few electrical points which are too often assumed as self-evident by writers on theory. The following are the principal results arrived at:—

1. The change of shape of the E.M.F. wave that drives the synchronising current.

2. There is only one position of lag or lead of a synchronous motor on a given load where the equilibrium is stable.

3. The necessity of adjusting the excitation of both the motor and the generator when we wish to get the maximum efficiency.

4. It is misleading to refer to a synchronous motor as having a certain power factor at a particular load. The power factor of a motor circuit is a variable that depends not only on the shape of the wave of the generator but also on what is happening outside the motor circuit.

5. The greater the excitation of two alternators working in parallel, the nearer the angle of lag between the synchronising E.M.F. and the synchronising current is to 45° and the less the resistance of the circuit of the armatures (Mordey's rule) the better will they work in parallel.

6. Alternators will in some cases cease to work in parallel on heavy inductive loads. This could be remedied by connecting condensers or over-excited synchronous motors either directly or through the medium of a transformer to the bus bars.

* *Science Abstracts*, 1901, p. 100.

E

LONDON UNITED TRAMWAYS.

By the courtesy of the managing director, Mr. J. Clifton Robinson, we are enabled to commence to-day an account of the huge undertaking which is being developed by the London United Tramways, Limited, in the west of London. Many and long were the controversies and negotiations which the company had to conduct before arriving at its present position as the pioneer in the great work of providing high-class, instant, and constant inter-communication between London and its important western suburbs. The first care of the directors was to seek Parliamentary power for the conversion to electric traction of the original tramways, and for certain extensions. To this end negotiations were entered into with all the local authorities having control of the districts concerned, these including, in the first instance, the London County Council, the Vestry (now Borough Council) of Hammersmith, the authorities in Acton, Ealing, Hanwell, Brentford, Chiswick, Hounslow, &c. Under agreements eventually made with these bodies, the company's first Act for conversion and extension was obtained in 1898, and in the same year, under a provisional order granted by the Light Railway Commissioners in the face of opposition and confirmed by the Board of Trade, power was acquired to construct a light railway, to be worked as an integral portion of the company's electric tramway system, and extending from Hanwell to Southall, Hayes, Hillington and Uxbridge. In the lines so far authorised there was, it will be seen, a conspicuous gap, namely, between Acton (the company's original terminus on its north section) and the starting point at Hanwell of the line authorised to Uxbridge. There is no intention here to revive the controversies now happily forgotton, but it is needful to recall the fact that without the connection through Ealing, the Southall—Uxbridge line would have remained isolated and practically valueless. In the 1900 Session of Parliament, the assent of Ealing Council (formerly declined by the narrow majority of one vote) having been obtained, the company was given power to make the needful connection through Acton and Ealing to Hanwell, &c., and in the same Act statutory power was obtained for the extension of the southern line already authorised from Kew Bridge through Brentford to Hounslow, so as to construct tramways in Heston, Isleworth, Twickenham, Teddington, Hampton and Hampton Wick.

In the present Session the company is promoting a Bill and a Light Railway Order for the construction of further

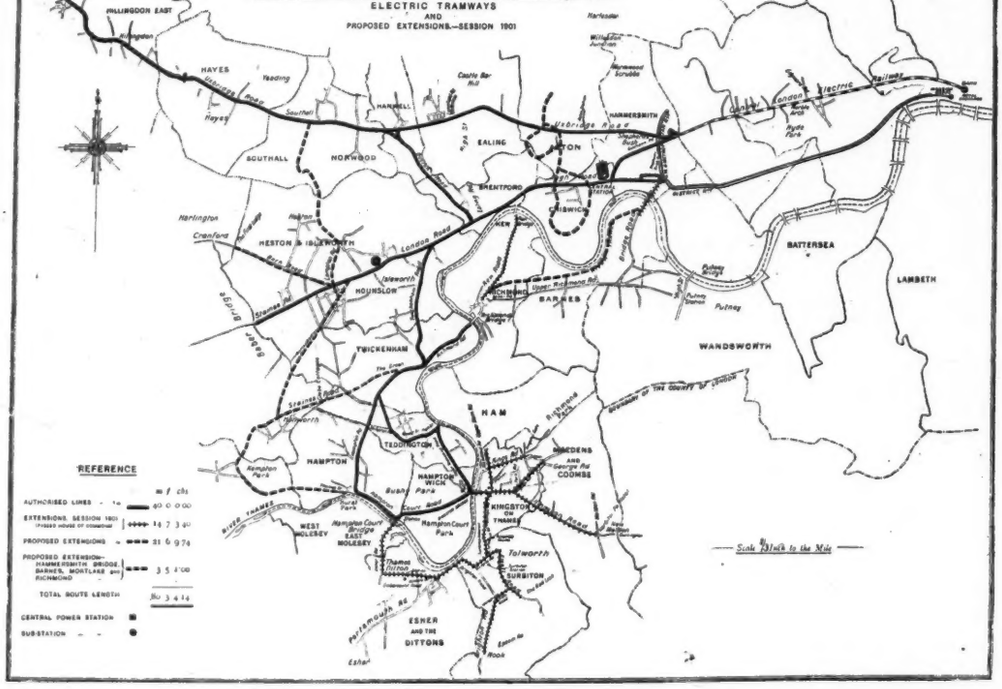
(1) That the shapes of the E.M.F. waves are such that

extensions, as shown in the map below. These are designed still further to link up the western districts of London, and to bring the important royal boroughs of Richmond and Kingston-on-Thames, with the surrounding townships of Surbiton, Esher, the Maldens, &c., into the same rapid through communication with each other, and with the Metropolis itself.

Thursday, April 4th, 1901, will remain a memorable day in the story of London tramway enterprise. On that day 7½ miles of electric tramway route—the first in London—were brought into operation, new cars of the most modern and luxurious character being for the first time offered for the public use. The lines then opened were three in number, namely :—

	Miles.	Furlongs.
Shepherd's Bush to and through Acton ...	2	5
Shepherd's Bush *vid* Goldhawk Road and Chiswick to Kew Bridge	3	6
Hammersmith to Young's Corner, Chiswick	1	1

being a total length of 7½ miles. The description to be given later of the electric equipment provided in the central power station, Chiswick, will indicate the nature of the operations which had to be undertaken before even this small instalment of the new electric system could be made ready. The Act authorising these works was, as already stated, passed in the Session of 1898, but it would convey a wrong impression if it were supposed that the interval of nearly three years between the passing of the Act and the inauguration of the new system was necessarily occupied in these preparations. Some time was lost in the early stages of the work, through the wish of the company to obtain the sanction of the London County Council to the use of overhead trolley wires within the County of London, the Council having stipulated at first for the adoption of an underground conduit system within its bounds. The sanction of the County Council to this change having been obtained, the work of construction was vigorously carried on, and it may be confidently stated that had no other hindrance arisen the inauguration of electric tramways in London might have taken place nearly a year sooner than it did. But an unexpected difficulty was presented in the demands of certain scientific authorities connected with Greenwich and Kew Observatories. It was alleged that stray or leakage currents from the rails of the company's tramways, if the rails were used as the return, would injuriously affect certain observations as to the variations of the earth's magnetic field. On this account clauses were adopted in the Act, putting the company's future progress entirely in the hands of the Royal Society and the Board of Trade. Conferences were held in October, 1899, between the representatives of these institutions and representatives of this and other companies interested, including all the electric railway companies then formed in London, but after the lapse of a year it was found that no basis of agreement had been arrived at. Another period of nearly six months elapsed, with no prospect of settlement, and meanwhile the company's capital to the extent of not less than half a million of money was lying idle. The opinion of practical men that it was not a question of the observation of sun spots, but the convenience of millions of people in London that was at stake, no doubt helped the final solution, when the chairman of the company boldly appealed to the Treasury direct, and by personal influence and argument brought about a settlement. This successful negotiation, the result of which was the resolve to remove the delicate instruments from Kew to some place beyond the radius of the supposed malign influence, was brought to a close, and the agreement was signed on Wednesday, April 3rd, at the Treasury. The authorities, of course, agreed to the settlement "for a consideration," and the case was so pressing, that their terms were accepted by the company. Without an hour's delay the preparations for acting on this arrangement were made, and on the morning of Thursday, April 4th, the entire working of the system was changed. Horses and horse-cars disappeared from the West London tramways, never to be seen there again, and 100 elegantly appointed electric tramway cars have from that day till now been running, frequently at minute intervals, for some 20 hours a day without interruption and without mishap. At times the pressure of traffic has been phenomenal. On Good Friday, Easter Day, and Easter Monday, the cars were not only crowded within and without, but vast crowds struggled for a place at the various termini, so that



the company had to requisition its construction gangs from the extension lines to preserve order and protect the cars from being swamped. On Whitsun Monday, although the immediate novelty had worn off, the pressure was even more severe than before. Splendid weather prevailed, and a record was established for seven miles of tramway such as had never been attained in this country. It may be stated that on Sunday, Monday, and Tuesday of Easter week, the cars conveyed 385,000 passengers, while for Whitsun Sunday, Whitsun Monday and Tuesday, the record increased to 443,000 passengers, the maximum in one day being reached on Whitsun Monday, when the passengers numbered 210,657, or an average of over 2,100 people carried on each car. The fares collected averaged above 1½d. per passenger, showing that the larger part of the crowd took the full extent of the run of the cars.

At Shepherd's Bush lies the terminus of the Central London Railway—the "Twopenny Tube." On the opening of the electric tramway, starting from that terminus to Kew, Acton, &c., quite a remarkable demonstration of the value of electric traction was brought to the knowledge of London. It was found—and many thousands of persons have since acted on the discovery—that a delightful holiday in one of London's choicest public resorts, Kew Gardens, could be enjoyed for the sum of 8d.! This was the object lesson which the directors of the company had so long desired to bring before the minds of the people of London, and the remarkable, the indeed phenomenal, success of the lines on the great public holidays has demonstrated how thoroughly the public has learned it. From the Bank (the "Tube" City terminus) to Shepherd's Bush costs 2d. At the exit from the underground electric line are found the splendid cars of the London United Tramways, conveying the passenger to Kew Bridge for another 2d., the whole journey occupying considerably under one hour. The return occupies the same time, and costs the same sum, so that for *8d.* an inhabitant of London discovered that he could enjoy a double journey of about 12 miles, or 24 miles in all, occupying less than two hours in the journey, with a whole day in Kew Gardens. Is it not true that a revolution in London in internal travel has been effected alike in cost, in comfort, and in time? It may be sufficient to contrast the facts here stated with the complaints only recently seen in some of the leading London newspapers as to the slowness, the infrequency, and the cost of the much-vaunted suburban *railway* service. In place of one train an hour, here is a "tube" train every three minutes, and electric cars at the terminus thereof, supplying a constant service of three-minute, two-minute, even *one*-minute intervals when necessary to meet the public demand.

The extensions opened on July 10th, concurrently with the celebration of Charter Day in Ealing, have doubled the extent of electric overhead tramways in operation in London, while they are but the prelude to the construction and opening of further lines, which will multiply the mileage more than threefold. The first extensions made are the following:—

	Miles.	Furlongs.
1. Acton, through Ealing to Hanwell ...	2	7
2. Hanwell to Southall	2	0
3. Kew Bridge through Brentford to Hounslow	3	1

or eight miles in all. While the lines numbered 1 and 2 above are stated separately, they are, in fact, continuous, starting from the terminus of the original lines at Acton, and giving from Shepherd's Bush to Southall an unbroken run of 7½ miles. When the "light railway" extension is completed to Uxbridge this line will then give a total of 12 miles of continuous running.

In the same way, the extension from Kew Bridge through Brentford to Hounslow, will be operated continuously, from the two termini at Shepherd's Bush and Hammersmith Broadway. From the "Tube" terminus, *viâ* Goldhawk Road, through Chiswick and Brentford, the run will be (as in the Southall case) a total of eight miles. From Hammersmith the journey will be very nearly the same in distance, and through cars to Hounslow will run on this route.

From Hounslow the direct line will, when completed, reach to Baber Bridge, Staines Road; while from a point in London Road the line to Twickenham will strike off, passing through a large portion of this lovely district, sending off a branch to touch Richmond Bridge on one hand, and on the other proceeding to Hampton Court, thence to Kingston Bridge, and on through Hampton Wick and Teddington to a junction with the authorised line at a point south of Twickenham Green. Those extensions will form an addition of 24 miles to the system, while the mileage promoted by the company in the present session, including light railways, exceeds 36 miles, giving a total route mileage of 60 miles to be added to that now open for traffic. The longest unbroken line which a passenger may take on this system, when completed, will be from Uxbridge on the north-west to New Malden or Hook on the south-west, a distance of 17 to 20 miles, while a splendid run will be that from Shepherd's Bush to Kempton Park.

In the Bill now before Parliament the tramways for which power is sought include a new mileage of over 25 miles. An important part of this group is a line to run from Hammersmith Broadway, by Bridge Road and Richmond Road, to the Royal borough of Richmond, joining there with the existing horse line from the south side of Kew Bridge (which will be converted to electricity), and having a spur thrown out eastward to reach Putney station. Another good section is on the south side of the Thames, coupling up with the Hampton Court and Hampton Wick lines across Hampton Court and Kingston Bridges, passing through the main streets of this other distinguished Royal Borough, and branching out to Coombe, the Maldens, Surbiton, and other favourite suburban residential spots.

The light railway order which the company is promoting in the present session provides for the construction of light railways, from the existing lines in the High Road, Chiswick, *viâ* Chiswick Lane, through Burlington Lane and Sutton Court Road, across High Road, Chiswick and Acton Green; while other sections cover portions of Bedford Park, and serve the northern portion of the parish of Acton. Other lines will connect the existing and authorised lines of the company at Southall with those sanctioned and constructed in Hounslow, by Norwood Green, Heston, and Lampton, thus supplying much-needed travelling facilities in portions of Middlesex sadly deficient in means of communication. From the existing terminus at Hounslow it is also proposed to obtain powers for the construction of a light railway to Kempton Park, forming a loop connecting with the authorised Twickenham lines.

The opening of the second section of this extensive system will enable the company to bring before the public eye, more effectually than has ever yet been done, the great revolution in tramway fares which the introduction of efficient electric traction has brought about. The company is, so far as all its lines are concerned, actually tied down by *statute* to an average fare of about *one halfpenny per mile.* There are no halfpenny fares, but the average run for a penny is about two miles. Further than this, the company is under the like statutory obligation not to charge increased fares on Sundays and public holidays. Still further, it is bound at certain hours of the day, prescribed by the Board of Trade, and liable to revisal by the Board on complaint from the public, to run cars *at one-half those charges* for the conveyance of the working classes to and from work. The statute uses the words "the labouring classes," and the obligation is to run those cars "for artisans, mechanics and daily labourers" at such times as "may be most convenient for such workmen going to and returning from their work." Our great railway stand-by is the Parliamentary train at 1d. a mile; but here is a Parliamentary fare at *one farthing a mile.* The company has no inferior cars, and intends to have none. As no one can tell who is and who is not a "daily labourer," the cars at the scheduled hours will be simply open to all—first-class accommodation *at one-fourth of the rate of third-class fare!* It may be added that by no known method of traction except that adopted by the company, the overhead electric trolley, could such rates possibly be undertaken as a statutory burden.

(*To be continued.*)

Society of Arts.—Sir W. H. Preece, F.R.S., has been elected chairman of the Council for the ensuing year.

THE QUESTION OF ELECTRICITY WORKS LOANS.

The Local Government Board inquiry on the 9th inst. at Surbiton was of more than usual interest.

The questions involved went far beyond the ordinary application of a local authority to borrow money for an electrical installation under a provisional order.

The Urban District Council of Surbiton obtained their powers as long ago as 1891—evidently with no intention of working them—and the Board of Trade have exercised extraordinary patience in not revoking the order years ago.

From time to time negotiations have been entered into with companies prepared to undertake the supply, upon favourable conditions for the ratepayers, finding all the capital and expert knowledge, and offering the local authority an option of taking over the undertaking at a valuation as a going concern, if it proved sufficiently successful to warrant its being converted into a municipal business.

In the face of proposals of this kind, the Urban District Council have entered into a provisional agreement for finding the capital to enable a cable manufacturer to compete with the supply companies upon extraordinary terms.

At Croydon and Beckenham somewhat similar arrangements were made. In the former case the Corporation obtained possession of the undertaking within 12 months, on payment of a small premium; but at Beckenham the cable company who became the contractors are in possession of the business, the loan having been authorised by the Local Government Board without any discussion upon the peculiar nature of the contract, the transaction being considered as an ordinary application for a loan to carry out the first installation by the local authority under their provisional order.

At Surbiton the proposed transaction has been fully discussed and some important points raised.

Instead of carrying out the provisional order as a municipal undertaking, or transferring it to a company on terms, a contract has been entered into with Callender's Cable and Construction Company, Limited, subject to the grant of the loan, under which the Urban District Council find the capital, the company working the business for their own account, and providing for the interest on the loan and sinking fund.

The Council having paid for the plant at scheduled prices—and the company run the concern for five years—the Council have the option of taking it over on paying 10 per cent. premium on original cost, or at the end of seven years, on payment of £4 13s. 4d., per cent. and after 10 years, without premium.

No allowance whatever is to be made for depreciation and renewal of plant, consequently the Council, if they purchase, have to pay original cost and a premium for the possibly antiquated and partially worn-out plant.

If no purchase is made the contractors go on working the concern, the Council finding all the capital for extensions.

This would practically amount to a transfer of the order, without the consent of the Board of Trade, the Council finding the capital for a private company to speculate with, and to enable them to push the sale of their manufactures, by making what the brewers call "tied houses" of the towns willing to operate upon these lines.

At the inquiry the inspector to the Local Government Board intimated that *he should not go into the agreement*, and evidently was dealing with the matter as an ordinary loan transaction, without reference to the peculiar character of the arrangement, which was more in the nature of a transfer than a contract to construct works.

Under an ordinary transfer the Council could make similar terms as to the prices to be charged for current, option of purchasing the undertaking at the end of fixed terms, and there would be no interest or sinking fund to provide for, as no capital would be found; it is difficult, therefore, to see what advantage the town can possibly obtain from such an uncommercial transaction.

Mr. Talbot, the consulting engineer advising the Council, admitted that if the concern were taken over in 10 years there would be considerable depreciation, and that the life of a cable was "anything up to 25 years." This evidence confirms what we have so strongly contended for, viz., that the sinking fund for repayment of the original cost of the plant does not provide for depreciation and renewal, which, according to Mr. Talbot, would amount to 4 per cent. per annum if the life did not exceed 25 years.

In our opinion, the proposed transaction is really a transfer, and if the Local Government Board view it in that light, nothwithstanding the precedent of Beckenham, it will be interesting to follow the case to the Board of Trade, and see how that department will deal with the principle of transferring the order and finding the capital to work it.

PARLIAMENTARY COMMITTEES.

Manchester and Liverpool Electric Express Railway.

The Committee did not sit on Tuesday last week, but on Wednesday further evidence was given by Mr. F. Behr, who was cross-examined by counsel for the London & North-Western Railway Company, and said that the system of electric power to be used was an ordinary continuous current of 1,000 volts. High speed was entirely a question of electrical power, and he did not think the curves would affect the passengers. There was no truth in the statement that at the Brussels trial a passenger was thrown from his seat and put his foot through the side of the carriage. He did not think they would have to stop at a retardation of 6 ft. per second if they were travelling at a speed of 110 miles per hour. If they had to stop it would in no way interfere with the passengers, because in retarding for a high speed, the feeling of discomfort was much smaller than when retarding from a low speed. Driving a train at 110 miles an hour would be a novelty on a large scale, and he had never heard of a greater power than 750 volts being used for driving purposes.

In answer to the Chairman, Witness said that no new dangers connected with the mono-rail had suggested themselves to him. He knew of nothing in the Bill to prevent the promoters allowing a little more space between the carriages.

Mr. Robert E. Cooper, civil engineer, gave evidence and expressed the opinion that as long as the laws of nature remained in force a train could be run with perfect safety on the line, and he believed even the railway companies did not propose to alter the laws of nature.

The Committee adjourned.

At Thursday's sitting of the Committee, Mr. Cooper was cross-examined by Mr. Littler on behalf of the Cheshire Lines Committee, and was questioned with regard to the promoters being able to turn the railway into a stopping railway if it was a failure as an express line.

The Chairman thought this was a line of argument which need not be pursued, as he did not see that the promoters could object to the insertion of a clause to prevent them making it a stopping line.

Further examined, Witness said there would be sufficient space on the railway as designed to allow for a distance of 2 ft. 6 in. between the passing cars. He did not think that on the two-rail system of the Baltimore and Ohio Railway, trains had run at the rate of 130 miles an hour on a curve, but he was aware that a speed of 85 miles an hour had been attained on the New York Central Railway, where there had been no short curves.

In re-examination, Witness said the capital powers would be ample for any extra expense the company might be put to with landowners, but the landowners were not making objection. The guide rails were not to prevent the car running off the rails but to steady it, and to steady it as much on the straight as in going round a corner. The most perfect theoretical form of car would be to have it without guide rails. They had a model made on that principle, and it worked with remarkable freedom and smoothness. A passenger weighing 12 stone would have a lateral pressure of 67 lbs. going round a curve, which really meant that so far as the seat was concerned the 12-stone man would be a 13-stone man going round a curve. The effect on the man himself would be that suppose he were tilted to an angle of 30°, he would not know physically that he was going round the curves at all, though the seat would have another stone on it.

Mr. J. M. Dobson, civil engineer, expressed approval of the plans and sections prepared, and pointed out that there would be stiff gradients at each end of the line which would be a distinct advantage in assisting starting at one end and slackening speed at the other. A train going at 110 miles on the level could be pulled up in 40 seconds in 1,100 yards. He thought the permanent way would compare very favourably with that of the two-rail system. The single rails would be heavier and would have to carry less.

Witness, in cross-examination, stated that in his opinion the route was the very best which could be selected as they avoided interfering with valuable properties and thereby saved expense.

Mr. Shelford, civil engineer, also gave evidence in support of the scheme, and pointed out that the peculiar advantage of the mono-rail system, combined with electric traction, was that curves could be negotiated at a high speed with perfect safety.

The Committee again adjourned.

On Friday evidence was given by Dr. E. Hopkinson, who, amongst other large electrical schemes, carried out the City and South London

London Road the line to Twickenham will strike off, passing

elected chairman of the Council for the ensuing year.

Railway. WITNESS said he had no doubt as to the possibility of running a train electrically equipped at 110 miles an hour with perfect safety and economy. The weight of the motors would be about 2¾ tons, and he estimated the cost of the electrical equipment at £464,000. He considered that all that was necessary to secure safety was an intelligent application of electrical principles, and from the point of view of derailment the mono-rail system possessed advantages which were possessed by no other railway system.

Mr. S. B. COTTERILL, the chief engineer and general manager of the Liverpool Overhead Electric Railway, endorsed the evidence of the preceding witness and had no doubt as to the scheme being a financial success.

Mr. J. W. CLOUD, chairman of the Westinghouse Brake Company, stated that it was not correct to say that the Westinghouse brake could not be applied at speeds over 55 miles per hour, for the quick acting brake had been applied at much higher speeds. He had himself been on trains when the brake was applied with efficiency at a speed of between 70 and 80 miles an hour, and it was confidently expected that the high-speed Westinghouse brake would stop a train running at 110 miles an hour in 3,330 feet. The magneto-electric brake could be applied as well, but it was not expected to apply both at once. There was hardly any limit to the power of the magneto-electric brake, and if the structure would bear the strain it could be applied as well as the Westinghouse brake.

Baron F. DE BUCKMANN was examined with reference to the Brussels experiments, and said that many travelled on that line without the slightest fear of danger. In his opinion there was no danger.

Sir W. H. PREECE was shortly examined, and said, that having carefully examined the scheme from an electrical point of view, he considered the safety of the passengers was well provided for.

The Committee adjourned till Tuesday.

On resuming on Tuesday, evidence was given by Sir W. H. BAILEY, a member of the Joint Committee representing Manchester and Liverpool, who was appointed to investigate and report upon the feasibility of the promoter's scheme. Witness said the Committee were quite satisfied that the railway was perfectly practicable, and that it would be a very great advantage to the inhabitants of Liverpool, Manchester and Salford.

Mr. E. GUTHRIE, also a member of the Committee, gave similar evidence, and said he was prepared to take shares in the company to show his belief in the scheme.

Mr. PARSHALL, electrical engineer of the Central London Railway, said he had paid much attention to the question of electric traction, and he did not see why a speed of 100 to 130 miles an hour should not be run with perfect safety and comfort. In his opinion there was no good ground for suggesting that the proposed motors would not supply all the propelling power needed.

Cross-examined by Mr. POPE, WITNESS said he was satisfied that the trains at a speed of 110 miles an hour could be supplied with effective brake-power. He had seen an electric railway running at 75 miles an hour, and which, at that speed, was a commercial success. In his opinion there was scarcely any limit to the speed at which an electric railway could run; it was entirely a question of competition and of commercial practicability. The only thing that militated against speed on railways was the danger of derailment, and there was less danger of that on the mono-rail than on any other system yet invented.

Major CARDEW, formerly electrical adviser to the Board of Trade, gave evidence similar to that which he tendered before the previous Committee as to the practicability of the mono-rail.

Sir F. BRAMWELL also gave evidence in support of the scheme, and said he was clearly of opinion that the speeds mentioned by previous witnesses could be attained on the mono-rail with perfect safety. As regarded comfort he should say that the mono-rail was far ahead of the two-rail system. He did not think any inconvenience would be experienced by passengers in running round curves. He did not see any necessity for an emergency stop brake; in fact, he had never had to consider a railway where there was less need for brake power than there was on the mono-rail. He should say that it was possible to go at a greater speed with more safety on the mono-rail than to travel at a lower speed on the ordinary railway systems.

Replying to Mr. LOUGH, M.P., WITNESS said he could not conceive the possibility of the cars ever getting derailed.

Local evidence having been called in support of the Bill, the Committee adjourned.

WEST CUMBERLAND ELECTRIC TRAMWAYS BILL.

THE Select Committee of the House of Lords, presided over by Lord Welby, considered on Tuesday the West Cumberland Electric Tramways Bill. The Bill has already passed the House of Commons. It is proposed under the Bill that a company be formed with a share capital of £400,000, and £100,000 borrowing powers, with the object of constructing 31 miles of tramways. The tramways will run from Cleator Moor through Whitehaven, Workington and the Maryport to Silloth, and will serve a population of 120,000. Power is also taken to erect a generating station and to supply electricity for public and private purposes within certain limits. For the convenience of local authorities who might desire to purchase, the line is divided into 17 separate tramways most of which will run along public roads. The estimate for the generating stations and works under the Bill amounts to £361,597.

The only opposition before the Committee was that of the Cleator Moor Urban District Council in respect to the widening of a bridge.

The Committee found the preamble of the Bill proved.

LONDON COUNTY COUNCIL TRAMWAYS.

ON Monday a Select Committee of the House of Lords, presided over by Lord Hatherton, commenced the consideration of the Tramways Bill of the London County Council. Mr. Freeman, K.C., Mr. Talbot, and Mr. Du Cane represented the County Council, and there were various appearances by counsel in opposition to parts of the Bill.

In opening the case for the promoters, Mr. FREEMAN explained that by the Bill the London County Council sought to obtain powers to construct certain new tramways, to reconstruct and alter certain existing tramways and to equip them for electrical traction. Power was also sought to widen streets where necessary. The existing tramways in London had been constructed by various companies, with the inevitable result that the systems were not complete. In 1900 the Council introduced a Bill to connect a great number of the lines and to introduce a uniform system for working the cars by electrical traction. Parliament had approved the main portions of that Bill, and the present Bill was needed to complete that measure. The first tramway proposed to be constructed was a short length of double line from the Archway Tavern at Highgate to the county boundary, where ultimately it would connect with the tramways which were being constructed by the county of Middlesex. Another line was to commence at York Road, Wandsworth, and proceed to Tooting *viâ* Red Lion Street and South Street—a distance of about 3 miles. Another tramway was to run from a junction with the previous line to the county boundary, where it would connect with a line which it was proposed to run in from Wimbledon. Another line sought to be constructed would run from Battersea Park Road to the foot of Albert Bridge, and there was also a proposal for a line to run from Stamford Street to Southwark Street. Then there was about 3½ miles of tramway running from Camberwell Green to Forest Hill Railway Station, and the last line of importance was one which would commence at a junction with the previous line, going across Peckham Rye as far as Stewart Road. Among the opponents to the Bill was the London, Camberwell and Dulwich Tramways Company, along one of whose lines for a short distance, one of the new tramways would run. They were afraid that the new tramways, being worked by electricity, might interfere with them. The fact was that the company had allowed their lines to get into a very bad state of repair and the undertaking was practically derelict, and ought, therefore, not to be allowed to stand in the way of the important work which the London County Council sought to carry out. The Corporation of Battersea also petitioned for special powers in order to regulate the breaking up of the streets for the purposes of the tramways, but the answer to that was that there were about 28 local authorities in London, and it was of the utmost importance in such a Bill as the present that there should be uniformity of treatment in respect of those areas.

Mr. J. WILLIAMS BENN, Chairman of the Highways Committee of the London County Council, gave evidence as to what the Council had done in regard to the tramways, and said that altogether it had purchased about 80 miles of trams in London out of a total mileage of 115. With the exception of 5 miles, the whole of the remaining 35 miles not in the hands of the Council would be purchaseable in 1903.

Replying to Mr. Mayer, who appeared for Battersea, WITNESS said that the County Council could not depart from the bargain they had made with all the other local authorities, and give them greater protection with regard to their electrical wires in connection with their electric light undertaking. The act of 1870 gave the local authority adequate protection in that respect.

Sir Alex. Binnie, engineer to the London County Council, and Mr. A. Baker, the manager of the Council's tramways, having given evidence in favour of the Bill, the Committee adjourned.

On the Committee resuming on Tuesday, Mr. BAKER was cross-examined. He said that one of the proposed lines would have to run over about 150 yards of the London, Camberwell and Dulwich Tramway Company's lines, and probably they would have to lay down new lines for the old ones. The County Council would not interfere with the traffic while the reconstruction was being carried out. They would work an electrical car on the line, although the line would also be used by horse cars. This car would be worked by a live line, consent to lay which could be obtained from the local authority. In the middle of the track over which the horse cars would run there would be a slot, ⅝ in. or ¾ in. wide, and a flat iron 3 in. or 4 in. wide. There was a similar line at Brixton which worked well.

Evidence having been given by Mr. YOUNG, the valuer to the London County Council, relative to the cost of the street widenings proposed in the Bill,

The Committee again adjourned.

SHANNON WATER AND ELECTRIC POWER BILL.

LAST week a Select Committee of the House of Lords, with Lord Welby in the chair, had before them the Bill of the Shannon Water and Electric Power Company. Mr. Bushe, K.C., for the promoters, explained that the object of the Bill was to incorporate a company with a capital of £360,000, and borrowing powers to the extent of £180,000 for the purposes of carrying out a scheme to utilise the water of the Shannon for the purpose of obtaining supply of electrical energy for power and lighting purposes over an area of 30 miles radius. The power station is to be situated 4½ miles from Limerick. The scheme had the approval of the locality, and the only opponent was a Major O'Connor, who was interested in an island on the river. The promoters had offered that gentleman most liberal terms, which however, he refused to accept. After hearing evidence on both sides, the Committee passed the preamble of the Bill.

admitted that if the concern were taken over in 10 years there would be considerable depreciation, and that the life of

On Friday evidence was given by Dr. E. HOPKINSON, who, amongst other large electrical schemes, carried out the City and South London

TRAMWAY PROVISIONAL ORDERS.

TRAMWAY Provisional Order (No. 2) Confirmation Bill, which has passed the Lords, was before the Examiner of Standing Order Proofs in the House of Commons on Thursday of last week, and further standing orders were ordered to be complied with. The Bill deals with the tramways in the following towns and districts:—Birkdale, Crompton, Leamington, Royton, Swindon and Wrexham. Full particulars were given in the ELECTRICAL REVIEW when the Bill was before the House of Lords' Committee.

CLYDE VALLEY ELECTRICAL POWER BILL.

LORD WELBY'S Committee of the House of Lords have had the Clyde Valley Electric Power Bill under consideration for several days. Mr. Freeman, K.C., Mr. Wilson, and Mr. Strain appeared for the promoters, and the petitions against the Bill were the Clydebank and Dumbarton Corporations, Paisley Corporation, and the Motherwell Corporation.

Mr. FREEMAN, K.C., stated that the object of the Bill was to supply a large area in the West of Scotland with electric energy, and it had already passed the House of Commons. The promoters were large manufacturers and colliery owners in the district and would themselves take the electricity generated, and it was not a financial scheme for the making of large profits. The area of supply would be 700 square miles, and there were about 1,200 works in the district covered. In the House of Commons there had been a competing scheme, but the Committee of the Lower House decided that the present Bill was the better one, and consequently the scheme of the Caledonian Electric Power Company was thrown out. The Corporation of Paisley objected to mains being laid through the streets to supply works beyond, and the ground of objection of the other Corporations was that these were not excluded from the right of the company to supply. What they wanted now was a clause that the company should not supply within their respective areas without their consent.

Sir DAVID RICHARDSON, one of the promoters, was called, and explained the advantages that would accrue to the manufacturers and others if the scheme was allowed to pass. He thought it was necessary that mains should be carried through Paisley, and with regard to the other burghs, he considered they were not in the position to supply power satisfactorily, and he did not think they were entitled to go in for what was practically a speculation.

Mr. R. ROBERTSON, of the firm of Messrs. Strain & Robertson, joint engineers of the scheme, with Sir W. H. Preece and Major Cardew, stated that for some years his attention had been directed to the needs of such a scheme in the district. The intention was to supply electricity chiefly for power purposes from large generating stations, and the advantages of such a scheme were that they might use large generating units. By grouping a number of works there would be less expense than in a number of small stations, and they would get a better average load during the whole day. Of the 26 works at Motherwell, 20 were favourable to the scheme, and several of these might require over 1,000 H.P. They did not intend to compete with the burgh in lighting, and as a matter of fact, they could not do such a thing without the consent of the burgh or the consent of the Board of Trade, if the consent of the burgh was unreasonably withheld. When the Bill first came before Parliament, 19 burghs were included in the area of supply, but the Houseof Commons excluded Govan, Partick, Port Glasgow, Paisley and Hamilton. He felt convinced that the Burgh of Motherwell would not go ahead to supply the needs of the town in the way that was proposed in the Bill, and, in fact, he believed it was beyond the scope of a corporation of that size to do such a thing. The capital of the company would be £900,000, with borrowing powers of £300,000. As regarded the opposition of the Burgh of Paisley he contended that the company would be put to considerable unnecessary expense if they were prevented from laying mains through that town in order to supply Johnstone. He was of opinion that the company could put up a generating station cheaper than Motherwell, because outside the town they could get land cheaper, and they would not have to give an elaborate finish to the buildings.

In cross-examination by counsel representing Clydebank, Dumbarton and Paisley on the point of carrying mains through the streets, WITNESS said it might be a little cheaper if they took the mains through the country roads.

In further cross-examination, WITNESS expressed the opinion that Motherwell would do well to take its supply of electricity from the company.

Lord HAMILTON OF DALZELL, one of the promoters, gave evidence in support of the Bill, and mentioned that by the exclusion of burghs from the area by the House of Commons 289 works were excluded.

Mr. R. ROBERTSON recalled, said the difference in the cost of laying a cable in a paved street as compared with a macadamised road was 1s. per yard, or about £88 per mile. If they had to take their cable outside Paisley the increased distance would involve them in a cost of between £15,000 to £25,000. The promoters had great support in Johnstone, and there was a prospect of great success in that town. The company had placed the principal generating station at Motherwell, because in the neighbourhood of and in that burgh, there were the largest number of works which could use electricity advantageously.

Mr. A. PREECE, of Preece & Cardew, civil engineers, said that the cost of putting pipes or cables through granite sett streets in a town and macadamised roads in the country, was 3s. a lineal yard.

Bailie SHEARER gave evidence to the effect that when his new works at Clydebank were completed he would require about 1,500 H.P. He had considered the cost of putting down plant for himself and had come to the conclusion that it would be more economical to support the company.

A large number of witnesses were called to give evidence, as manufacturers, of the boon the company would be to the district.

Mr. BALFOUR BROWNE, K.C., addressed the Committee for the Motherwell Corporation, and said that the works affected in the burgh by the Bill only numbered 26. In 1895 the burgh got a provisional order, and under compulsion by the Board of Trade, had set up an installation. He contended that it would be contrary to public policy to let the company into the town now. The Corporation were supplying electric energy at from 2½d. down to 1½d. per unit for power purposes, and he submitted that they could supply it as cheaply as the company. He thought it was unfair to exempt Hamilton from the Bill, and leave in Motherwell. It would be a serious detriment to the Corporation of Motherwell if competition was allowed.

Councillor JOHN FROOD was called, and stated that the Motherwell Corporation had spent £30,000 on the electrical undertaking. At present they had 550 H.P., and that was sufficient for all present demands.

In cross-examination, WITNESS admitted that at present they only supplied 70 H.P. for power, but said that they had only started in February.

Amongst other witnesses called were Mr. W. M. Mordey and Mr. B. Jenkins, both electrical engineers, of London, who gave evidence to the effect that the Corporation could supply electricity even cheaper than the company.

Evidence was called on behalf of Dumbarton as to the inconvenience which would arise from laying down mains in the streets.

Mr. POLLOCK addressed the Committee for Clydebank and Dumbarton, and submitted that these burghs ought to be excluded from the Bill in the same way as Govan, Paisley and Partick.

The Committee passed the preamble of the Bill, but ordered alterations to be made so as to give Dumbarton the right to object on reasonable grounds to the entry of the company, and leaving the question of the passage of the mains through Paisley or otherwise to the decision of the Board of Trade.

WATFORD TRAMWAYS.

THE Watford and District Tramways Bill which has passed the House of Commons was on Thursday last week before Earl Morley's Committee of the House of Lords on Unopposed Bills. The Bill incorporates the Watford and District Tramways Company, and empowers that committee to make and maintain tramways and other works. There are 13 sections of tramways proposed, the total length being 8 miles 6 furlongs 1·90 chains. Power is given to take land in the parish of Bushy Urban on which to erect an electricity generating station. The estimated cost of the works is £88,827 0s. 5d., including £22,000 for the generating station and car shed, and £6,374 for street and bridge widenings.

The Committee decided to strike out the clause in the Bill giving the Middlesex County Council the right to purchase in the event of the local authority not exercising their right, as the County Council was not the purchasing authority in this case under the Act.

Further considerations of the Bill was postponed.

On Tuesday the Bill came again before Earl Morley's Committee. The necessary alteration in the clause regarding purchase by the local authority, which was dealt with at the last sitting, was made, and the Bill ordered to be reported for third reading.

BOLTON CORPORATION BILL.

HAVING passed the House of Lords, the Omnibus Bill of the Bolton Corporation came before the Committee of the House of Commons on Unopposed Bills on Thursday last week. Under the Bill the Corporation proposes to construct 26 sections of tramways of a total length of nearly 16 miles. It is proposed to connect the existing lines of the borough with those of the South Lancashire Tramways Company, and so complete the tramway connection with St. Helens, Wigan, and Manchester. Workmen's tramways are to be provided before 8 a.m., and after 5 p.m., at a charge not exceeding ½d. a mile. The estimated cost of the tramway works is £560,000 including the street improvements consequent on the extension.

SMETHWICK CORPORATION BILL.

THIS Bill, which confers powers upon the Corporation with respect to tramways and electric light and other matters, was passed as an unopposed measure by the House of Commons' Committee on Thursday last week. Power is given to purchase by agreement any authorised tramways outside the borough which form continuations of existing tramways within the borough, and the adjoining local authorities or any company may lease their tramways to the Corporation by agreement. Power is given to reconstruct the existing tramways for electric traction, and the Corporation is authorised to supply electricity for tramway purposes within or without the borough subject to the consent, in the latter case, of the local authority.

WORCESTER TRAMWAYS.

THE Worcester Tramways Bill, which grants power to the Worcester Tramways Company to reconstruct the existing tramways and construct additional tramways and work them by mechanical traction was before the Committee on Unopposed Bills of the House of Commons on Tuesday, and was ordered to be reported for third reading. The Bill has already passed the House of Lords.

Moor Urban District Council in respect to the widening of a bridge.
The Committee found the preamble of the Bill proved.

of the Bill.

LONDON COUNTY COUNCIL.

The Council resolved on Tuesday to lend £10,065 to the Battersea Borough Council for electric lighting purposes, and £18,703 to the Stepney Council for similar works.

Testing of Meters.—Dr. Collins—on the motion for the reception of the report of the Highways Committee—asked the chairman whether any difficulty had been experienced in the testing of electricity meters, and, if so, what steps were proposed to be taken in order to prevent such inconvenience to the public in the future.

Mr. J. W. Benn stated, in reply, that there had been some difficulty in the testing of meters at the Council's station. This was partly due to the fact that the premises were limited. The Committee were endeavouring to overcome the delay by utilising other buildings for the purpose.

Subways.—Mr. J. R. Cousins inquired whether the Committee were considering the question of subways, and whether they had been in communication with the Post Office authorities, the gas and water and electric lighting companies, as to the question of their contributing towards the cost of the subways.

In reply, the chairman remarked that the question of subways was still under the consideration of the Committee, especially in regard to the most important matter of shallow underground tramways. The Committee would consider the question of applying to Parliament for compulsory powers to cause the companies to use the subways.

The Tramway Power Station.—The Highways Committee reminded the Council that power was obtained in the London County Tramways Act, 1900, to acquire the freehold of the leasehold portion of the Camberwell tramway depôt and certain adjoining property, and to use the whole as a generating station for the tramways. The Act also authorised the Council to enter into an agreement with the London, Chatham and Dover Railway Company for a siding from that railway to the power station, whilst powers were being sought to acquire for the same purpose the site of St. Matthew's Girls' School premises adjacent to the depôt. It appeared that difficulties had arisen in securing a site for the reinstatement of the schools, and the railway company desired to make a stipulation that the use of the siding should be restricted to three hours in the night time. The Committee stated that this would present a most serious difficulty, as the consumption of coal at the generating station would be very large, and should, from any cause, there not be at any time a sufficient quantity for use, the Council would be precluded from obtaining a fresh supply along the siding except within the specified hours; and thus the supply of power for the whole of the tramways operated from the station might be seriously imperilled. Another drawback in connection with the site is that, as it is not at the waterside, engines of the condensing type could not be used there, and the very large quantity of water required for the engines would have to be obtained from a company in the ordinary way. Having considered all the circumstances, the Committee had come to the conclusion that, although the Camberwell site at first appeared, from its position in practically the centre of the Council tramways area, the best for an electricity generating station for the whole system, it is unsuitable in other respects for the purpose. It had therefore been found necessary to seek another site free from the same objections. The Greenwich tramway depôt, which is the property of the Council, has not the above-mentioned disadvantages, although it has not the advantage of being near the centre of the tramway system. Thus, if the site were utilised the Committee stated there may be some leakage of current in transmission which will, however, be a very slight matter compared with the advantages afforded by the use of the site for the purpose indicated. The depôt has a frontage to the River Thames, and by this means facilities would be afforded for the unloading of coal from barges directly on to the premises, and the delivery of coal at the station would be effected without the Council being under any restriction as to times of delivery, which is a great and distinct advantage. The water difficulty would also be overcome, and engines of the condensing type could be used at the station. Although it will be necessary for the Council to acquire some property for the purpose of so enlarging the site as to render it suitable for the erection of a generating station, the cost of the property to be acquired will not be so great as that for the property adjoining the Camberwell site. The cost of the property adjoining the Greenwich site is estimated at £30,000, while the estimated cost of that adjoining the Camberwell depôt is £80,000. This shows that, independently of the other advantages to be gained by the adoption of the Greenwich site in place of that at Camberwell for the generating station, a saving of about £50,000 would be effected in the cost of acquiring the property necessary for providing a sufficiently large site. A proposal to utilise the Greenwich depôt was adjourned for a week.

LEGAL.

The National Company for the Distribution of Electricity by Secondary Generators *v.* Gibbs.

This case came before Mr. Justice Cozens-Hardy in the Chancery Division on Tuesday and Thursday last week.

Mr. Fletcher Moulton, K.C. (with him Mr. Gore-Browne), for the plaintiffs, said that no doubt his Lordship would remember something of this case, as it had been before him on a previous occasion.

After hearing counsel's arguments at some length, his Lordship, in giving judgment, having stated the facts and the course of the French proceedings, said that the plaintiffs in those proceedings obtained what in England would be called a judgment for specific performance against the defendants, and there was also an inquiry as to the extent to which the purchase price had been paid to the defendants, and the French Court held that so far as the shares which were part of the consideration were concerned, the vendors had had the purchase price, but that so far as the cash portion of the purchase money was concerned, there was a considerable sum of money due from the company to Madame Rouelle on behalf of Goulard's estate. It might be true that there was no order on the defendants to pay that sum, but the company admitted their liability to pay that which the French Court found was due. After the division of the House of Lords, adverse to the patents was given the plaintiff company said it should institute proceedings in England for breach of warranty. That was the action before his Lordship then. The plaintiffs then sought to make this case. "True," they said, "we owe to Goulard's estate a certain sum of money as part of the purchase money, but we are making a claim in England against Goulard's estate for damages and breach of warranty of the validity of the patents, and we ought not to be ordered to pay the balance of the purchase money until that question has been decided." His Lordship could not find that the question of breach of warranty was ever litigated in France, or that there was any finding of the French Court that Goulard's estate was not liable for breach of warranty. He thought in those circumstances the plea of *res judicata* did not avail Madame Rouelle, the defendant. He, therefore, held that the plea of *res judicata* was no defence to the claim for damages, and as it was also clear that the Statute of Limitations afforded no defence, the plaintiffs' case succeeded, and he must direct an inquiry as to damages.

In the result his Lordship directed that there should be judgment for the defendant on the counterclaim for £2,581 2s., with interest at 4 per cent. from that day, and judgment for the plaintiffs on the claim. There was an apportionment of the costs.

CORRESPONDENCE.

On Polyphase Generating and Sub-station Plant for Electric Traction.

In concluding the discussion under the above heading from my side, and in answer to Mr. Eborall's letter in your last issue, I should like to make the following remarks:—*Comparison of efficiency of rotary converters and motor-generators.* I cannot but repeat that the figures quoted by me represent "standard" American practice, and considering the extended use of this class of machinery in the States, I think they are as reliable as those given by Mr. Eborall from the Continent. The figure 89 per cent. full load efficiency for a (good) 500-kw. motor-generator set is not at all due to an arithmetical error as suggested by Mr. Eborall, but was taken from a test report of a well-known American firm which gives a standard set having rating:—

D.C. generator 8 poles, 500 kw., 400 r.p.m., 575 volts.
Efficiency = 94·8 per cent. full load.
93·05 per cent. ½ „
Quarter-phase synchronous motor, 20 poles, 530 kw., 400 r.p.m., 2,200 volts.
Efficiency = 94·3 per cent. full load (cos $\phi = 1$).
89·8 per cent. ½ „ „
Combined efficiencies = 89·2 per cent. (given by me, 89).
„ „ = 83 „ („ „ 83).

These figures include all losses, excitation as well as friction, and as the machines were tested in their own bearings, conditions are just the same as in actual practice.

Figures which exist only on paper are, of course, excluded from a discussion of this kind.

Damping Coils.—I would say that if the losses are as small as ·05 to ·075 per cent., it is a clear indication that they can be left away entirely, the solid pole-pieces surely being able to prevent hunting, as apart from additional cost and unnecessary loss in efficiency (small as this may be), such devices will impair ventilation, being placed between the poles.

Pressure Tests.—My figures conform with the latest rules laid down by the A.I.E.E., which surely embodies as good and as experienced engineers as there are on the Continent. Personally, I think that to test a 10,000-volt machine with only 15,000 volts is inadequate, as conditions may arise where, due to difference in wave shape, this margin gets considerably less, if, for instance, the test generator has a sine wave or even a flat wave, while the machine itself, or the system on which it will work, may have a peaked wave. It is evident

works at Clydebank were completed he would require about 1,500 H.P. He had considered the cost of putting down plant for him-

Commons on Tuesday, and was ordered to be reported for third reading. The Bill has already passed the House of Lords.

that machines tested according to American rules must have a better insulation, and therefore are to be preferred by the customer if other conditions are the same.

Fly-Wheel Effect.—Mr. Eborall gives in his first paper examples of enormous discrepancies in the value of fly-wheel effect, which were given for the same type of engine, and speed regulation by different firms. He puts it down to wrong design, while I want to suggest that the different engine builders may not have had the same ideas as to what per cent. of speed variation actually corresponds to our limit of 2, 2½ or 3 electrical degrees. This is very reasonable considering the complex nature of the problem; in any case the different "safety factors" which Mr. Eborall himself says are used by the different engine builders may make the most straightforward calculation ambiguous, if they are compared with each other. Therefore I proposed to get in such a case sufficient data from the engine builder's previous experience on his particular type of engine, and from these check the different tenders on the same basis. The approximate method given was a step in this direction. In drawing final conclusions *re* hunting, I proposed not to use calculated values, as very often they differ considerably from actual values obtained by tests due to reasons given. I mentioned the electrical method of measuring speed variations as having been found to give greater accuracy than either method stated by Mr. Eborall. I hope this will explain my reasoning in the matter.

H. S. Meyer.

Rugby, *July 15th*, 1901.

Three-wire Tramway Supply.

Regarding the advice given to "Silex" by Mr. J. C. Stewart in your issue of June 21st, I am surprised at the lack of foresight displayed by Mr. Stewart in proposing to insulate the rails of a tramway system. It is very evident that to have rails at a pressure of 500 volts above or below earth in a public street as suggested, in case of a fault to earth developing on one of the outside conductors, is altogether out of the question; but apart from this, the expense and difficulty of insulating the rails would be sufficient to condemn the suggestion.

There seems to be no advantage in a three-wire system for traction work, unless the power house is some distance away from the tramlines, in which case some saving in copper would be effected by being able to distribute at 1,000 volts, but in most cases the balancing difficulties would more than compensate this saving. In a lighting system, where three wires are used, the two outside conductors are together the same size as one wire if the two-wire system were adopted, that is for the same power and voltage on the lamps, and the neutral or middle conductor is usually one quarter the size of one of the outside wires, thus a saving of 43¾ per cent. of copper is made, as compared with the two-wire system.

This is not so, however, in traction, for the rails that have nine or ten times the carrying capacity of the copper conductors, and which are necessary, whether used for carrying heavy currents or not, are used for the neutral wire, and the two copper outside conductors must be, to have the same C^2R losses, not more than double the resistance of the two conductors, rails and cables, in the two-wire system; in actual practice, however, the best size, considering interest, &c., would have far more than double this resistance, and therefore greater C^2R losses.

Where current is expensive to generate and where negative boosters and heavy negative feeders have to be used to keep down the drop in voltage on the rails, considerable saving might be made by adopting the three-wire system.

That balancing would be difficult may be taken from the fact that the plant load factor of a traction station is roughly $11 \times \sqrt[8]{c}$ where c = number of cars running, thus showing that with a moderate number of cars the load varies greatly, and further, this variation would be more on one side of the system than on both sides together, as the number of cars would be about half.

A. Johnston.

In my reply to inquiry by "Silex" regarding a three-wire system of tramway supply, I merely pointed out some of the difficulties encountered in balancing. There being no practical example of a tramway supply worked on this system at hand, I illustrated an up-to-date three-wire lighting one, where every precaution is taken to ensure, as far as possible, an uninterrupted supply. I did not mean him, however, to infer from my answer that no other objections arose in connection with the supply of power on this system. From the pressure he intends adopting, viz., 1,000 volts, I presume the generators are *all* to be connected in pairs in parallel series across the outers, with the point of intersection of the two joined up to the rail or mid-wire, thus reverting to the older method. Arranged in this way, the conditions are somewhat similar to a two-wire tramway system, if we consider only the running of the car load.

A breakdown of one side will not affect the working of the other. The balance at all times depending upon the distribution of the car load, the drop in the rail, and the condition of the outers, will vary proportionately as these do. "Silex" in desiring to introduce the three-wire system to tramway power transmission has no doubt the reduction of the current in the rail in view, more than any saving in copper that might result. It is even conceivable that under certain favourable conditions of load the current in the rail might partake of the nature of oscillations. However desirable this might be, he must still consider the effects of a leakage developing in the insulated negative outer. He must also recollect that the rail, in this case the earthed conductor, would act as positive lead to one half of the system. In their regulations the Board of Trade require that the return, if uninsulated or partly uninsulated, shall be connected to the negative terminal of the generator. This clause has been inserted with the object of preventing injurious electrolytic action on gas and water pipes and other metallic conductors.

With the proposed three-wire arrangement, a fault occurring on the positive outer would result in current leaving this lead and going to earth by various paths. A pipe forming a good earth connection would be a perfect acquisition to this runaway current; consequently, as there is no difference of potential between this pipe and the rail (the proper return), it will gambol home on the pipe, provided the conditions as to earthing have been carried out according to B.O.T. regulations. On the other hand, a fault developing on the negative outer would have the opposite effect, the current in this case rushing towards the fault along the pipe, and jumping off it wherever it found an easier passage. In this case the current *leaves* the earth conductor and enters the negative outer at the fault. For further information upon this point, I cannot do better than refer "Silex" to the evidence given before a Select Committee of the House of Commons, as published in your issue of June 28th. Being only an improver my practical experience can be of little value in a case that has taken years for our foremost electrical experts to arrive at what might be termed "good practice" in transmission of power.

J. C. Stewart.

Partickhill.

THE ENGINEER AS ARBITRATOR.

IT is one of the first principles of justice that he who sits to determine disputes between contending parties should be influenced by no bias in favour of one side or the other. With a view to ensuring that his case shall receive impartial treatment, the taxpayer contributes to the handsome salaries of the many distinguished judges who adorn the bench. It is our proud boast, that even if a judge of the High Court be hasty in his decision, or wrong in his law, no scintilla of prejudice in favour of one side or the other can have affected his judgment. If he be a shareholder in a company whose interests are at stake, he is often heard to divulge the fact before he allows the parties to submit their troubles for his determination. The ermine which adorns his robe is a sufficient guarantee that no private advantage, how near

something of this case, as it had been before him on a previous occasion.

even a flat wave, while the machine itself, or the system on which it will work, may have a peaked wave. It is evident

or remote soever, can shake the hand which holds the scale of justice.

Those engaged in commercial enterprise, who fly from Courts of Justice in order to have disputes settled by arbitrators of their own selection, are too prone to lose sight of the merits of the tribunals which they desert. Without attempting to hold a brief for litigation, as opposed to arbitration, we would fain point out that undue stress is sometimes laid upon the alleged delay and expense of the law, and too little emphasis is given to the impartiality, not to mention the finality, of a decision in the High Court.

Those who glance at the columns of this journal will have seen that electrical engineers are often called upon to determine all the matters in dispute which arise between the contractor who erects, and the local authority or company who provide the funds for, an electric light or power installation. The written contract contains a clause referring all questions to the arbitrament of the engineer employed by the company or the local authority, and the unfortunate contractor must submit to the decision of one who, from his very position, tends to have a mind biassed in favour of his own employers.

It were superfluous to point out that the vicissitudes of business render it necessary to have some such tribunal for the decision of questions to the solution of which the specification furnishes no clue; to ask a court of justice to determine such points would be absurd. Moreover, the fact of the contractor having put his signature to a document which contains a clause of this kind, implies that he is aware of the clutches into which he may fall. It is unfortunate that latter day competition should have compelled all contractors to humbly accept terms which place their interests in the power and control of the "city" or other "electrical engineer."

Although the Judges of the High Court, in laying down a principle to which they themselves faithfully adhere, are often heard to say that strict impartiality in the judge is essential in every Court of Justice, yet if the contractor put his name to some document similar to that above referred to, he will find it difficult to obtain redress for what he conceives to be the error or neglect of the engineer upon whom his claim to remuneration depends. The law upon this point has been thus summarised :—"If payment to the contractor is made to be dependent upon a certificate for the amount being given by the engineer employed, the contractor cannot sue for payment, or on a *quantum meruit*, at law or in equity before the certificate is given, even though it be not given by the fault of the engineer; nor can he sue the engineer for damages unless the certificate is withheld by fraud or by collusion or arrangement between the employer and the engineer." It is interesting to consider the important propositions contained in the above summary, with the help of a few cases which have arisen in connection with the conduct of an engineer or architect. The position of an architect for our present purpose is similar to that of an engineer. In Clarke *v.* Watson (18 C.B. N.S., 278), by the terms of a contract, certain works were to be done for the defendants by the plaintiffs according to plans and specifications, and to be paid for by certain instalments "on production by the contractors to the defendants, or one of them, of the certificate of the surveyor for the time being of the defendants, that they (the contractors) had duly and efficiently performed and completed such work to his satisfaction." In an action upon this contract, it was alleged that all things necessary had been done by the plaintiffs to entitle them to have the certificate of the surveyor that the work had been duly and efficiently performed and completed to his satisfaction, but that the said surveyor had not given such certificate, but had wrongfully and improperly neglected and refused to do so, &c. It was held that, in the absence of collusion, the plaintiffs were not entitled to recover without producing the surveyor's certificate; nor were the defendants responsible for the refusal of the surveyor to give one. It was pointed out by Chief Justice Erle that when contractors undertake to be bound by a contract which renders the certificate of their employer's engineer a condition precedent to payment, contractors must not be allowed to substitute the opinion of the jury for that of the engineer. In a subsequent case Lord Coleridge thus described the position of an engineer :—"I think if his position be such as I have described, he is not bound to give the grounds of his opinion, or to reconsider it, and that the person who has taken him for better or for worse, as one whose opinion is a condition precedent to the obtaining of a sum of money, cannot bring an action against him for refusing to give the ground of his opinion, or to hear evidence tendered to show that the opinion was wrong. . . . I at first thought he might on a certain view of the facts be regarded as an arbitrator who had not arbitrated, and that, perhaps, an action might be maintained not for doing his duty ill, but for not doing it in any circumstances."

Apart from the difficulty which must necessarily surround any attempt to prove fraud on the part of an engineer, the contractor will also find it no easy matter to ascertain what the Court will regard as fraudulent. Lord Justice Turner, in dealing with questions of fraud or collusion between the engineer and the employer, expressed the view that "It would be a fraud on the part of a company to have desired by their engineer, alterations, additions and omissions to be made, to have stood by and seen expenditure going on upon them, to have taken the benefit of that expenditure, and then to refuse payment on the ground that the expenditure was incurred without proper orders having been given for the purpose [Hill *v.* South Staffs. Ry Co. 12 L.T.N.S. 63]. A very clear case of fraud must be made out before the Court will question the certificate of the engineer, but if collusion be established and such collusion result in the dishonest withholding of the certificate, the contractor may then sue in the ordinary way for work done.

It seems, however, that inasmuch as the engineer of a company or local authority is appointed to exercise a judicial function, the contractor is entitled to know the terms of his employment. Thus in a building case, the architect undertook to erect a house for £15,000 including architect's commission and all expenses. He then employed a builder who gave an estimate upon quantities forwarded to him by the architect, and who ultimately did the work for £13,690. A clause was inserted providing for the settlement of all disputes by the architect. It was held in the circumstances of the case that as the architect was the agent of the employer, the builder was entitled to an account and payment in respect of extras (Kimberley *v.* Dick, L.R. 13, Eq. 1).

The fact that the arbitrator appointed in the manner above described is in fact, or is likely to be, biassed in favour of one side or the other, appears to have little weight with the Court where the validity of an award is called in question. The "professional honour" of the arbitrator is supposed to ride high above all the considerations which might affect the mind of an ordinary mortal. Lord Justice Bowen, in referring to this matter in Jackson *v.* Barry Railway Company [(1893) 1 Ch. 238] said :—"To an adjudication in such a peculiar reference, the engineer cannot be expected to, nor was it intended that he should, come with a mind free from the human weakness of a preconceived opinion. The perfectly open judgment, the absence of all previously formed or pronounced views, which, in an ordinary arbitrator, are natural and to be looked for, neither party to the contract proposed to exact from the arbitrator of their choice. They knew well that he possibly or probably must be committed to a prior view of his own, and that he might not be impartial in the ordinary sense of the word. What they relied on was his professional honour, his position, his intelligence; and the contractor certainly had a right to demand that whatever views the engineer might have formed, he would be ready to listen to argument, and at the last moment to determine as fairly as he could after all had been said and heard."

Further, in a later case it was decided that where in a contract for the execution of works the arbitrator selected by the parties is the servant of one of them, he is not disqualified by the mere fact that under the terms of the submission he may have to decide disputes involving the question whether he has himself, or his own son, has acted with due skill and competence in advising his employers in respect of the carrying out of the contract. Lord Esher said: "Where you have a man of high character, one whose character for impartiality cannot be impeached when he has to decide as to his own conduct, to say that such a man would not have enough honesty and

number of cars would be about half.

A. Johnston.

strength of mind to act impartially where his son's conduct came in question, is a statement which I cannot accept." His Lordship added somewhat significantly, "I do not believe it in this case."

Having regard to the difficulties which beset the contractor in his endeavour to establish collusion, and to the fact that presumed bias does not affect the decision of the tribunal which is thrust upon him, it is hard for him to know what course to adopt. The employer is secure in the belief that his engineer will not "let him down," and that if one contractor will not accept the arbitration clause another will. With his relationship to the engineer we have not now to do; the hardship seems to be on the side of the contractor. Nothing but united action can cause this monstrous clause to be modified or struck out of every contract relating to electrical undertakings. No doubt in 9 cases out of 10 substantial justice is done. In making his tender, the contractor must be presumed to consider all the circumstances of the case so as to derive an adequate net profit. But in our view the absence of any clause referring vital disputes to an independent tribunal, whether an arbitrator agreed upon by both parties, or to a court consisting of two arbitrators and an umpire, is a defect which ought to be forthwith remedied by combined action.

BUSINESS NOTES.

Electrical Wares Exported.

Week Ending July 17th, 1900.		Week ending July 16th, 1901.	
Alexandria	Value £51	Adelaide. Teleph. mat.	Value £85
Amsterdam	51	Alexandria	63
Bangkok	180	Amsterdam	80
Boca	1,141	Boca. Teleg. mat.	265
Bombay	216	,, Teleg mat.	222
Brisbane	26	Bombay	50
Buenos Ayres	169	Boulogne	100
,, Teleg. mat. ..	914	Brisbane. Teleg. cable ..	114
Calcutta	482	,, Teleg. instruments ..	350
,, Teleg. wire ..	260	,, Teleg. stores	83
Christchurch	44	Buenos Ayres	642
Colombo	85	,, Teleg. cable ..	800
,, Teleg. mat.	35	Calcutta	856
Constantinople	10	,, Teleg. wire	100
Copenhagen. Teleg. wire ..	478	Cape Town	873
Demerara. Teleg. mat. ..	150	Christiania. Teleg. wire ..	26
Durban	395	Colombo	667
,, Teleg. mat.	151	Copenhagen. Teleg. wire ..	92
East London	442	Durban	488
Fiume	21	,, Teleg. mat.	86
Ghent	15	East London. Teleg. sundries	206
Gothenburg	25	Gothenburg	12
Hamburg. Teleg. mat.	230	Hamburg. Teleg. mat. ..	550
Hong Kong	235	Hong Kong	74
Liban	10	Kobe. Teleph. apprts	325
Madras	14	Launceston	128
Mauritius	165	Lyttleton	115
Melbourne	111	Malta	1,000
Ostend	11	Maryborough. Teleg. mat. ..	1,161
Perth	16	Mazagan	812
Port Elizabeth	760	Melbourne	10
St. Petersburg	250	,, Teleg. wire	175
Shanghai	127	Napier	12
,, Teleg. mat.	126	Paysandu	800
Stockholm. Teleg. mat. ..	275	Perth	770
Sydney	146	St. Petersburg. Teleg. mat. ..	50
Valparaiso	50	Saigon	19
Yokohama	349	Stockholm. Teleg. mat. ..	87
		Sydney	671
		,, Teleg. cable	307
		Townsville. Teleg. mat. ..	848
		Yokohama	420
Total ..	£8,256	Total ..	£14,089

Foreign Goods Transhipped.

Melbourne. Telephones	Value £18	Cape Town. Elect. mat.	Value £260
		Colombo. Elect. lighting mat.	23
		Durban. Elect. mat.	40
		Hamburg. Elect. goods ..	20
		Total ..	£343

Arc Lighting.—Messrs. Crompton & Co., Limited, have received the order for the Motherwell arc lamp extensions, also an order for about 50 arc lamps from the Birkenhead Corporation for street lighting in connection with their tramway circuit.

Bankruptcy Proceedings.—The public examination of Alfred Ebenezer Mavor, electrical engineer, Putney, was held before Mr. Registrar Brougham at the London Bankruptcy Court on the 12th inst., the debtor applying to pass upon accounts showing debts £2,647 10s. and no available assets. In the course of his examination he stated that in April, 1897, he resigned the position of general manager of the Fowler-Waring Cables Company, and became managing director of the New Cycle Company, at Northfleet, at a salary of £1,200 a year. When that company went into liquidation, he acted for a time at a salary of £750 a year for the purchaser of the assets, with a view to resuscitating the company, but the attempt proved abortive, the cycle boom having passed away. At the end of 1899 witness took over the works in order to use them for a company to be floated to manufacture electrical fittings and accessories. He borrowed a considerable amount of money for that scheme, and, in fact, the greater part of his indebtedness related thereto. He had acquired certain options for patents for electrical cables and accumulators, some of which, although not in his own name, had been developed under his supervision. The project came to nothing, and he consequently had to come to the Court. The examination was concluded.

Bullock Works for England.—A New York cable to the *Liverpool Mercury* says that Mr. Bullock, president of the Bullock Electric Manufacturing Company, of Cincinnati, has left for England to acquire a site for the establishment of a British branch of the company.

Catalogues and Lists.—Messrs. W. Wilson Cobbett, Limited, of 59, Southwark Street, S.E., who are specialists in the transmission of power by belting, have issued a brochure with the title of "Wares in Warp and Weft," in which their manufactures of "Scandinavia" M.C.M. belting, conveyer belting, "Saturn" camel-hair belting, and composite beltings are detailed, and methods of joining are described. Belt stretchers, tackle for mounting, wide and heavy belts, and other specialities are included.

The Empire Roller Bearings Company, Limited, of Delahay Street, S.W., has issued a neat list showing its roller bearings as supplied for electric tramcars, works' shafting, &c. A list of some English tramway and railway systems upon which they are doing service is given, also a note of prices and detailed illustrations.

The B.T.H. Company's latest pamphlets are:—No. 101, Horizontal edgewise instruments; No. 102, Quick-break switches.

A very neat pamphlet has been issued by the Electrical Company, Limited, in which they describe and illustrate a three-phase 2,500 v. transmission of power plant designed and erected by them at the Frongoch Mine, Devil's Bridge, Cardiganshire.

Date Stamp.—Messrs. Baker & Co., platinum refiners, of Newark, N.J., have sent out to their customers and others a very handy little date stamp. We have been favoured with a specimen of this very compact and convenient little article.

Extension of Aluminium Patent Refused.—Before Lords Macnaghten, Davey, Robertson, and Lindley, and Sir Ford North, the other day, the British Aluminium Company, Limited, petitioned for the prolongation of letters patent granted in 1887 to Arthur Charles Henderson for the United Kingdom. The invention was that of a French gentleman named Héroult, who obtained patents in France and Belgium, both of which had expired. The English patent rights were first acquired by a Swiss company, who, however, did not work the invention, and the petitioners purchased the patent from the Swiss company in 1894 as a commercial speculation, but said that, owing to the large outlay in the erection of works, they had not had time to obtain adequate remuneration for their capital. The prolongation was opposed by the Attorney-General and by Mr. Dennis, an engineer and dealer in aluminium, of 11, Billiter Street, London, on the grounds:—(1) The position of the petitioners as assignees and purchasers of the patent as a commercial speculation; (2) that the statements in the petition and accompanying accounts did not supply any clear account of the profits made by the inventor, or even of those made by the petitioners themselves; (3) that no real attempt was made to introduce the patented article into this country for the first seven years of the life of the letters patent; and (4) the expiration of the foreign patents, which would render the prolongation of the English patent detrimental to the commercial interests of the country. Lord Davey delivered the considered judgment of the Committee. He said that they had humbly advised his Majesty that the petition should be dismissed, the petitioners to pay one set of costs to the objectors.

Foreign Electrical Goods.—June proved to be a quiet month as regards the imports of foreign electrical plant and apparatus into this country, the value for the month being returned at only £54,367, as compared with £90,281 in May last, and £86,171 in June last year. For the year to date, however, the imports show a large increase, having amounted to £552,966 for the six months ending with June last, as compared with only £420,353 in the first half of 1900.

For Sale.—The Newport (Mon.) Corporation is offering for sale certain plant at the electricity works, including a dynamo (110 v. 120 a.), switches, switchboard, arc lamps, &c.

Potters to the King.—Messrs. Doulton & Co., Limited, have been appointed potters to his Majesty the King.

Re Maximum Demand System of Charging.—We have received the following letter from Mr. S. Jevons, of Birmingham:—"With reference to the interesting correspondence which is going forward in your journal on the above subject, and particularly to the letter signed 'E. V. C.,' in which is suggested the incorporation of a clock with the indicator system, I trust it may not be out of place for me to mention that I have lately been supplying quite a number of automatic time switches for the very purpose mentioned. Amongst others these switches have been supplied to Brighton for the purpose, I understand, of short-circuiting the 'Wright' indicator during certain hours of the day. These time switches can be arranged to be kept going by the consumer, and a special attachment has been introduced for securing that the current used shall be passing on the high-rate side should the consumer allow the clockwork to run down. I shall be pleased to send any of the station engineers and others amongst your readers full particulars if they so desire."

of the engineer. In a subsequent case Lord Coleridge thus say that such a man would not have enough honesty and

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Lift Makers to His Majesty.—Messrs. R. Waygood and Co., Limited, who for many years held the appointment of lift makers to her late Majesty Queen Victoria, have been appointed by Royal Warrant lift makers to his Majesty the King.

Robertson Lamp in Miniature.—From the General Electric Company we have received a watch chain charm in the form of a tiny Robertson lamp. It has a gilt bayonet cap, and is a very pretty little ornament.

Stealing Copper.—Some marine store dealers have been charged at the Widnes Police Court with stealing and receiving copper valued at £132 10s., the property of the Electrical Copper Company, of Widnes. They were committed for trial at the Liverpool Assizes.

Storage Batteries.—Messrs. Ashmore, Benson, Pease and Co., Limited, Stockton-on-Tees, have completed the erection of works on their iron and steel works site in Bowerfield Lane, Stockton, for the manufacture and construction of electric storage batteries. At present they are completing a contract (£2,600) for a 280-cell battery for the Devonport Corporation for tramways and lighting purposes, and a 250-cell battery for the Mexboro' U.D.C.

To Dieppe.—The L.B. & S.C. Railway has issued a pretty little circular, in which in a chatty way are set forth the attractions of a Saturday to Monday trip to Dieppe. Those who are anxious for a breath of air between the working weeks might do worse than peruse these particulars.

Trade Announcement.—Mr. Claude M. Treadwell, of 49, Queen Victoria Street, E.C., informs us that he has taken Mr. C. H. Bernard Aylwin into partnership. The name of the firm will be Treadwell & Aylwin.

Victor Turbines.—We learn from Mr. Frederick Nell that the Stilwell-Bierce and Smith-Vaile Company, of Payton, Ohio, have just shipped to the North Carolina Electric Power Company, of North Carolina, U.S.A., a 27-in. improved cylinder gate "Victor" turbine mounted on horizontal shaft in a wrought-iron flume made entirely of bronze, working under 60 ft. head and to develop 750 H.P.; to the McCloud River Electrical Company, of San Francisco, California, four units of "Victor" turbines with cylinder gate mounted on horizontal shafts, each unit to develop 790 H.P. under 36 ft. working head of water and running at 270 revolutions per minute. Each unit consists of two 30-in. Victor turbines mounted in a steel flume, and discharging into one central draft tube. The flumes are 15 ft. 9 in. long by 9 ft. 6 ft. in diameter, constructed of heavy steel plate with cast-iron heads and covers. The gate work is of the draw rod type which places all gears on the outside of the flume where they can have attention, and where they can work in oil, doing away with the old style of gate work, where the gears run in water and where they are continuously causing trouble. The patents of this style of gate work, we understand, are entirely controlled by this company. This plant is now being installed in Northern California, U.S.A., and the wheels will be set on concrete arches, the draft tubes reaching through to the tail water below. Each unit is equipped with a large rope pulley, and the dynamos are driven by means of rope drive, being located at a higher elevation than the water wheels. The feeder pipes come through the foundations upon which the generators set. There are also two exciter wheels which will develop about 40 H.P., each under 36 ft. head, and the exciters are also driven by rope pulleys.

X Ray Tubes.—We understand that the gold medal given by the President of the Röntgen Society for the best tube suitable for X ray work, has been awarded to the Cox "Record" tube, for which Messrs. Harry W. Cox, Limited, of Cursitor Street, are the sole agents.

ELECTRIC LIGHT AND POWER NOTES.

Abertillery.—At this great Monmouthshire colliery centre the District Council has decided to call a special meeting to consider the electric lighting of the district immediately after the deputation who have inspected combined schemes for refuse destruction and electric lighting have presented their report.

Acton.—Messrs. Evershed & Vignoles have informed the Council that unless they can give them a supply of electrical energy within a reasonable time, they will petition the B. of T. to rescind the 1891 order.

Bedford.—Mr. Hope-Johnstone, who has had control of the municipal electricity works since their inception, has resigned his position. Those who are interested in the matter will find a full report of a very lengthy Council discussion on the subject in the *Bedfordshire Times* of July 13th. It seems, from the report, that he was paid a salary and a commission on capital expenditure, but the Committee asked him to agree to a fixed inclusive salary of £400.

Bradford.—A motion was brought forward at the last meeting of the City Council to increase the salary of the city electrical engineer, Mr. R. A. Chattock, from £500 to £700 a year, but there was active opposition to the proposal, and the chairman of the Electricity Committee ultimately withdrew it.

Bury.—The L.G.B. has sanctioned a £11,346 loan for electric lighting, but has struck out £120 for incandescent lamps as "they were not considered proper subjects for a loan."

Canterbury.—The second assistant engineer at the electricity works, Mr. W. A. Kemm, has resigned; Mr. Lewis has been promoted to the post of chief assistant.

Cardiff.—At a meeting of the E.L. Committee, the chairman (Alderman Carey) said he had a very satisfactory report on the electrical turnover. Last year they made a loss, as the Committee would know, of £1,700. This year, after paying £4,187 interest and sinking fund and all expenses, they made a loss of £75 19s. 3d. But they had paid £97 10s. on account of repairs to the Ferranti engine, in regard to which they had £1,056 in hand. The department, therefore, made a profit of £21 10s. 9d.

The engineer and manager (Mr. Arthur Ellis) has presented a report showing that during the month of June there had been an increase in the power generated (compared with the corresponding period of last year) of 43 per cent. The figures were 57,250 units, compared with 39,879. The revenue had increased by 54½ per cent.

Carshalton.—The Electrical Power Distribution Company has promised the U.D.C. to commence the work of cable-laying forthwith.

Caversham.—The U.D.C. has appointed a Committee to consider the advisability of applying for electric lighting powers.

Church Stretton.—The Church Stretton Land Company is to apply for a prov. order for the district.

Colwyn Bay.—The electrical engineer has reported to the U.D.C. that the consumption of electricity for the quarter of the year which ended on June 24th amounted to 9,172 units, as against 8,721 in the previous quarter, an increase of 451 units.

Cromer.—The D.C. is going to ask for an extension of time of two years for its prov. order. There has been so much dilly-dallying about the matter here that we think the extension ought not to be granted.

Dartford.—The U.D.C. has appointed Mr. A. J. C. Waterland resident engineer at the electricity works. In its new Bill the Council will seek powers to wire consumers' premises, and also to supply energy in bulk to places outside its district.

Dorking.—The Leatherhead and District Electricity Company intends applying for a prov. order for the parish of Mickleham.

Edinburgh.—It was reported at the Electric Lighting Committee the other day that of the 7,000 H.P. of machinery at Dewar Place station there are about 4,000 H.P. at work, leaving 3,000 in reserve, which is ample for all contingencies during the summer months, when M'Donald Road station is shut down.

Egham.—The R.D.C. has received notices of the application on the part of the Staines and Egham Light Railway Company for a prov. order for lighting the district.

Elland.—By seven votes to four the U.D.C. have decided in favour of adopting Mr. Walter Emmott's electric lighting installation for the district, and of Messrs. Meldrum's scheme for disposing of refuse to be run in connection therewith. The Council have just completed an abortive attempt at considerable cost to obtain Parliamentary powers compelling the local gas company to sell their rights.

Epsom.—Mr. H. F. Foster, of Dover, has been appointed clerk of works and resident electrical engineer to the District Council. Energy is to be charged for at the uniform rate of 6½d. per unit. Lord Rosebery, in the course of a discussion, made some remarks impressing upon the officials the desirability of canvassing outside the compulsory area to see what probable consumers there were.

Esher.—The Provincial Electric Supply and Traction Company has given the D.C. notice of its intention to apply for a prov. order.

Gillingham.—The D.C. have just received the report of the valuers appointed to fix the purchase price of the New Brompton and Gillingham undertaking of the Chatham and District Electric Lighting Company. Mr. C. T. Smith valued for the vendors, and Mr. W. H. Trentham for the Council. The price agreed upon is £26,659. If the Board of Trade approves of this sum, purchase can be completed by the Council without a provisional order or Act of Parliament.

Hartlepool.—The Council has decided to put in hand the £18,000 electric light scheme drawn up by the borough engineer, Mr. Crummack.

Hereford.—The Finance Committee has drawn up an estimate of income and expenditure in connection with the electricity works for the ensuing year as follows:—Estimated expenditure, £2,719; estimated income, £2,513—balance required, £206. The amount includes repayments of principal to the extent of £900.

Ingleton.—The Ingleton E.L. & P. Company has applied for a two years' extension of its electric lighting license.

Kirriemuir.—The Lighting Committee is considering the question of electric lighting for the borough.

Leamington.—The borough engineer may shortly look into the question of the cost of a special installation for the Pump Room Baths, the Town Hall, and the new Free Library. The reason is given that the increased terms of the Midland E.L. Co. will add 50 per cent. to the cost of the lighting of the premises.

Leeds.—The electric lighting of Leeds covered markets has been transferred from the gas-driven plant to the Corporation's street mains. This necessitated changing the feeding point, and generally altering the previous arrangement. The installation consists of two sections, public lighting and private lighting, each again divided and balanced in two distinct circuits. The public section, consisting of 96 Lewis arc lamps arranged in circuits of five lamps in parallel on 200 volts on a pair of 7/16 cables, give ample light for general purposes, whilst a pilot circuit of 10 lamps running across the bays, enables the night sweepers to clear away the refuse in the early hours of the morning. Such advantage has been taken of the private lighting mains by the various stall holders, who find it most convenient. At the lower end of the eastern side of the markets, some 14 fish shops have been fitted up with six 50-c.p. lamps, each wired in steel screwed tubing with waterproof fittings to enable the tenants to wash down the whole shop. Provision is also made for extensions on the north-east side. The whole of the work has been carried out by the Corporation staff, under the direction of the electrical engineer.

Llanwrst.—Two tenders have been received by the U.D.C. for electric lighting. One from the Electric Light Company, quoted 25s. per lamp and £4 10s. for each arc lamp. The Holyhead and North Wales Gas Company offer to supply gas for incandescent lamps which would give 120 c.p., for 18s. per lamp.

Lowestoft.—It being considered necessary to extend the electricity works plant, Mr. Hawtayne has reported recommending the installation of a 500-kw. set. This, with switchboard and piping work, will cost £6,000. Improved battery regulating gear is to be provided. A loan is to be applied for and tenders invited, and the committee has powers to place the contract without further reference to the Council.

Marlow.—The Provincial Electrical Supply Company will apply for a prov. order for Marlow and neighbourhood. The water power of the Marlow Weir is spoken of in connection with the scheme.

Morpeth.—The Northern Counties Electricity Supply Company proposes to apply for a provisional order, and is to have an interview with the Council.

Penzance.—A deputation has been inspecting the electric lighting arrangements at Plymouth and Torquay in view of the steps contemplated by the Penzance Council.

Perth.—The City Chamberlain has been authorised to borrow £5,000 on temporary loan for electric lighting purposes.

Pokesdown.—Both the Poole Electric Traction Company and the Bournemouth Corporation intend applying for a prov. order for electric lighting here.

Simon's Town.—At the meeting of the Municipal Council the minutes of a special meeting detailed the scheme submitted by Messrs. Siemens, Limited, for installing the electric light at a cost of £7,100, which included the requirements of Sir John Jackson & Co., the contractors for the new Dock Yard. Should this firm not join the Council, the alternative scheme would cost £4,400, working out at about 7d. per unit. This would include 125 lamps of 32 c.p. to burn 10 hours per night. It was resolved that the Mayor and Messrs. Siemens's representative (Mr. Johnson) interview Sir John Jackson & Co. on the matter. The minutes were confirmed.

South Bank.—The Middlesbrough *Gazette* says that a special meeting of the D.C. will consider whether to apply for a provisional order.

Swansea.—Mr. Cawthra, the electrical engineer, has prepared a report on the first quarter's working of the borough lighting scheme. The works have been supplying current day and night since May 13th, and 29,300 units have been supplied to 103 customers. After meeting all charges, with the exception of interest and sinking fund, there is a profit of £173 4s. 3d. over and above working expenses.

The resident engineer has recommended extensions at a cost of £15,820.

Thornaby.—The T.C. has received a notice from the Cleveland and Durham County Electric Power Company and one from the Northern Counties Electric Supply Company stating that each of these bodies intended to apply for provisional orders for electric lighting. In consequence of these applications the Corporation has resolved to apply for a provisional order.

Wakefield.—The West Riding Asylums Committee has appointed Mr. Herbert de Grave to continue for another 12 months as electrical clerk of works, and to increase his salary from £3 to £4 per week. The consideration of the question of the electric lighting of Menston and Wadsley asylums has been adjourned for three months.

Walney Island.—A L.G.B. inquiry was opened at Barrow-in-Furness last week respecting the borrowing of £12,340 by the Barrow Corporation for additional electricity works, to provide new street and private lighting for the coming winter at Vickerstown, Walney Island. The cost of carrying the electricity mains across Walney Channel will be slightly over £6,000.

Wells.—The B. of T. has revoked the city of Wells electric lighting order of 1896.

Yeovil.—The T.C. has decided to continue its opposition to the scheme of the Provincial Electric Supply Company.

ELECTRIC TRACTION NOTES.

Barnes.—In consequence of the House of Commons' Committee giving sanction to an addition to the London United Tramway's scheme from Hammersmith to Lonsdale Road, the U.D.C. has decided to petition against the company's Bill.

Bath.—Mr. Hopwood held an inquiry at the Board of Trade offices on 10th inst. to hear the objections raised to the Bath and District light railways scheme. The unsuitability of site for generating station, narrowness of streets, and carriage of bicycles, were points debated.

Bradford.—The Bradford Tramways Committee has unanimously approved a proposal for the immediate conversion of all the existing horse and steam tramway routes into electric services, and it is expected that this proposal will pass the Council at its next meeting practically without opposition, and that the conversion to a large extent will be completed by about next February. As a result of the Parliamentary proceedings in connection with the Bradford Improvement Bill, which has just ended, terms had previously been arranged for the buying out of both the old tramway companies on all their routes, and about 15 additional miles of tramway will also have to be constructed under the new scheme. In making the estimates of the results of these extensions it is calculated that the average number of miles run per day per car will be 100; the average receipts per mile on all sections 1s. per car; the average services on all sections 9½ minutes; the operating expenses 7d. per car-mile; and the estimated profit on the whole system, excluding fixed charges, a little over £50,000 per annum. So rapid has been the extension of tramway facilities in this part of the West Riding lately, that in the course of a few weeks it will be possible to make a tramcar journey from Leeds, through Bradford and Halifax, to Ludden Foot, a distance of 20 miles, by changing cars at the ends of lines which practically meet.

Colchester.—The T.C. last week appointed a deputation to wait on the Board of Trade with reference to the proposed adoption of a system of cars propelled upon the electric trolley principle, but without the expense of tramlines.

Croydon.—The Tramways Committee of the local County Council reported that they had "again carefully considered the adoption of the best practical method of dealing with any risk that may arise in consequence of the possible breaking of telegraph, telephone, and trolley wires, and have been in consultation with Mr. Monkhouse (the electrical adviser) on the subject." They recommended that "the system to be adopted should be one of 'automatic cut-outs,' which would, in the event of telephone or telegraph wires falling across the trolley wires, or in the event of the trolley wires themselves breaking, instantaneously disconnect the current. The estimated cost of the adoption of this system is £3,050."

Dublin.—What might have been a very serious accident occurred on the Dublin and Lucan Electric Tram Company's line on Sunday. About 10 o'clock at night the last tram leaving Lucan for Dublin ran into the Chapelizod car at Conyngham Road. The cause of the accident was that one of the passengers, wishing to leave the car while the conductor was on top, pulled the trolley rope, and the pole slipped off the wire, stopping the car, and putting out the light. Before the trolley pole could be adjusted the Lucan tram came up, and the night being dark, ran smash into the other. The cars were both considerably damaged, and some of the passengers were greatly shaken.

A singular accident happened to the motorman on an electric tram on the Dollymount line on Friday night. When close to Malahide Road he thought he saw something on the track, and in a desperate effort to bring the car to a standstill as quickly as possible he burst one of the leading veins in his leg. He stuck manfully to his post till he reached Dublin, when he was at once taken to hospital in a very weak condition from loss of blood, and he lies in a critical state.

Dublin tramway men held a big meeting last Friday, and decided to form a trades union organisation.

Hampton and Hampton Hill.—The U.D.C. has accepted the proposal of Mr. J. Clifton Robinson to meet the Council and discuss terms as to the London United Tramways Light Railway schemes.

Houghton-le-Spring.—The first step towards the practical commencement of this work has been taken in the letting of the contract, the tender of Messrs. Dick, Kerr & Co., of London, having been accepted, the sum being stated to be about £170,000. The Houghton-le-Spring and Sunderland District Tramways—to give the system its full name, is being promoted by the United Kingdom Tramways, Light Railway and Electrical Syndicate, and the object is to provide a ready means of intercommunication between numerous places in the populous north-east district of the

they were not considered proper subjects for a loan."

the question of electric lighting for the borough.

county of Durham. If the scheme is carried out in its entirety, it will probably be about 25 miles in length It will connect with the Gateshead system on the north, and will extend to Easington in the south-east, an area of many miles in extent, and embracing the greater part of the mining centre of that portion of the county. The system is to be that of the overhead trolley.

Kirkcaldy.—The Council has accepted the offer of George Smith & Sons, Kirkcaldy, for the construction of the permanent way for the electric tram system, amounting to £21,224.

Liverpool.—The electric cars are each being provided with an emergency outfit, to enable the conductor or roadman to deal with minor mishaps as they may occur, without loss of time. The outfit consists of a pair of rubber gloves, a wire cutter with insulated handles, a length of rope, and a key to the electric section boxes; the whole being contained in a small box. The lid of the box is self-closing, and a square of glass is fitted in one side of the box. To open the box the square of glass must be broken. A lever on the inside must then be lifted and the lid may be opened. By an interruption of the supply of current from the district generating station, the cars on the main routes of the Liverpool system, lying along Walton Road, Stanley Road, Seaforth and Everton Valley were stopped on Monday afternoon for upwards of an hour. Running was resumed before the heavy evening traffic began.

Manchester.—The deadlock between the two Corporations of Manchester and Salford has not yet been removed, although a draft agreement has been drawn up for the consideration of the Committees interested. Meantime the week-end traffic receipts on all the electric car routes in Manchester are reported to be extremely satisfactory.

Middlesex.—The Earl of Jersey held a Light Railway Commissioners' inquiry at Wood Green on 10th and 11th inst., regarding the Middlesex County Council's light railway scheme. There was a great deal of evidence given for and against.

Morecambe.—Messrs. Ledward & Heape, of London, are to interview the Morecambe and Heysham Councils in regard to an electric tram project.

Nottingham.—The second section of the Nottingham Corporation electric tramways—from the Great Market Place to Bulwell, a distance of about four miles—has been completed, and the first trial trip was made at midnight on Friday. The passengers on board the car included representatives of the Corporation, the contractors and the officials of the electrical department. As soon as the Board of Trade inspection has been made the line will be opened for traffic. It is proposed to utilise 25 cars on this section. Meanwhile rapid progress is being made with the Trent Bridge and Station Street sections, and it is hoped to start the Lenton section early in the Spring of next year.

Perth.—After a good deal of discussion the Town Council have come to the resolution to offer the Perth and District Tramways Company the sum of £20,000 "for their whole property within and without the burgh, such sum to cover all legal expenses connected with the transfer, and that, in the event of this offer being refused, the Council take no further steps in the matter in the meantime." Should the company accept the offer, the present horse haulage system will be dispensed with for electric traction.

Peterborough.—The Corporation has accepted the terms of the B.E.T. Company for the supply of municipal energy for working the trams. The company will pay 2·5d. per unit for the first 75,000 units, 2d. for the next 75,000, 1¾d. for the next 50,000, and 1½d. for all in excess of 200,000.

Radcliffe.—The Board of Trade has given formal sanction to the borrowing of money for electrical tramways in the Radcliffe district. The order sanctions the spending of £46,845 for permanent way and car sheds, £11,602 for electrical equipment, £6,103 for cars, and £450 for costs incidental to obtaining of the order.

Richmond.—The T.C. by 24 votes to 6, has rescinded its provisional agreement with the London United Tramways, Limited, notwithstanding that the company undertook to accede to the Council's conditions.

Russia.—Negotiations are in hand with regard to the conversion of the horse tramways in the town of Nicolaieff, South Russia, into electric lines.

Sedgley.—Considerable progress is now being made in the reconstruction and electrical equipment of the tramway between the Sedgley depôt and the Bull Ring.

Sheffield.—The Tramways Committee's recommendations for increasing the salaries of the principal officials were vigorously discussed by the City Council on Wednesday. The proposal was to raise the salary of Mr. A. L. C. Fell, general manager, from £600 to £700, and that of Mr. Dugdale, traffic superintendent, from £200 to £250 per annum. In moving the adoption of the Committee's report, Alderman W. E. Clegg said he made these proposals entirely on his own initiative, and because he thought the officials thoroughly deserved the increase. Councillor Wardley moved that the proposal be sent back to the Committee. He said he objected on principle to these rapid increases. Mr. Fell came a few years ago for £400; then he was raised to £600, and now it was proposed to give him £700. Mr. Shaw seconded the amendment, and Mr. Whiteley said the complaints against these increases were not confined to the working classes, but were to be heard from shopkeepers and business men. Sir Charles Skelton remarked that the Tramways Committee might be trusted to know what their officials were worth. Mr. Shaw said that Mr Fell had gained experience as a manager of such a concern, and ought to be satisfied with that, as he probably was. It was very nice to increase the salaries of officials, but there was nothing to be proud of in paying a man 20s. for 48 hours work. Aldermam Gamsford supported the committee, and Mr. G. Senior said they had got a good man, and Mr. Fell deserved the advance. Mr. Fenton said Mr. Fell's work since he came to Sheffield was surely good enough to warrant an advance to £700. Alderman Clegg said one would imagine from the observations of some of the members of the Council that the tramway system was one of the worst in the whole country, instead of being, as it was, one of the best. Deputations from all parts of the country had been to Sheffield to see how their system was worked, and how it was managed. Those deputations went away and copied them. He did not know whether the amount paid to Mr. Fell was, or was not, over and above what other places were paying for similar services, but in London the manager of the system was getting more salary, although he was without Mr. Fell's experience. On a division the amendment was defeated by 27 votes to 20, and the report adopted.

Sunbury.—The U.D.C., in discussing the Middlesex County Council light railway scheme, expressed itself in favour of the full statutory width of roadway in their district, with double lines throughout, and for the completion of the work within two years. Counsel have been instructed to attend the Commissioners' inquiry at Hounslow on 22nd inst. into both the C.C. and L.U.T. proposals.

Sunderland.—The T.C. has formally resolved to object to the proposal of the British Electric Traction Company, Limited, to make a junction of the South Shields, Sunderland and District Light Railways with the Borough Tramways. The Sunderland tramways at present extend northward to the very verge of the borough, and the British Company propose to make a line from South Shields southward towards Sunderland, and desired power to enable them to bring their passengers into Sunderland over the Corporation lines.

Teddington.—Mr. J. Clifton Robinson has sent the U.D.C. plans and particulars of the L.U.T. light railway scheme affecting the district. The line (which is No. 3 in the schedule) commences at Hanworth, and passes along Staines Road to Twickenham Green. It will be worked on the trolley system from the company's central power station at Chiswick, and there will be through fares and connections in the whole of the company's system. The Council has given notice of objection to these proposals, and also to the similar light railway scheme of the Middlesex County Council. The U.D.C. are inquiring of the company as to when they intend to construct the local tramways already authorised to Hampton Court.

The Underground Railway.—The Electric Traction Company, which has undertaken to apply its system to the District Railway, is now said to have made an important offer to the Metropolitan Railway Company to extend the electrical system to the trains of that company also, and it is said that this offer is now under consideration.

Worthing.—Common sense was not allowed to prevail at the adjourned special meeting of the Council, which was convened to consider a memorial signed by 511 ratepayers against the proposed introduction of electric tramways. After a lengthy discussion, it was decided, by 13 votes to 8, not to apply to the Light Railway Commissioners for an order. What is to be the next step?

Yarmouth.—The Council has resolved to buy the Yarmouth and Gorleston Tramways Company's undertaking, if the Corporation will equip it for electric traction and then lease the system to the company for 30 years. The company would provide capital for rolling stock, and will purchase energy from the municipal electricity works at 2d. per unit for a minimum of 200,000 units. The Tramways Committee is to invite applications from different companies as to the terms upon which they would lease the tramways.

TELEGRAPH AND TELEPHONE NOTES.

Cape-Australia Cable.—At the House of Commons, on 11th inst., in answer to Sir E. Sassoon, Mr. Chamberlain said that no general contract will be signed between the Government and the Eastern Telegraph Company in regard to this Cape-Australia cable, but the conditions by which the company will be bound will be embodied in landing licenses shortly to be issued for this cable at Mauritius, Rodrigues and Cocos Islands on the lines indicated in his answer to his question of the hon. member of March 11th last. He had not received any appeals from Canada, Australia and the Cape that an expropriation clause should be inserted in these licenses.

London Telephone Service.—The Postmaster-General hopes to be able to begin the connection of subscribers with the Central Exchange and some others at the beginning of October.

by the Barrow Corporation for additional electricity works, to pro-

between numerous places in the populous north-east district of the

Melbourne Telegraphs and Telephones.—The *British Australasian* says:—"The conference of the electrical engineering experts of the Postal Department is being presided over by Sir Charles Todd, of South Australia. A thorough inquiry is to be made into the various services with a view to improving them. An interesting subject of discussion will be the use of the local telephonogram service, which means the sending and receiving of messages by telephone. Senator Drake, the Commonwealth Postmaster-General, has directed an inquiry into the desirability of introducing a system of high-speed telegraphy, such as the Wheatstone automatic, between the State capitals."

Telegraphic Interruptions and Repairs :—

CABLES.	INTERRUPTED.	REPAIRED.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Singaradya-Ampenan	July 3, 1901 ..	July 12, 1901
Basseterre-Les Saintes	June 29, 1901 ..	..
San Domingo-Curaçao	July 12, 1901 ..	..
LANDLINES :—		
Cayenne-Pinheiro	April 20, 1901 ..	..
Pekin-Kalgan	June 14, 1900 ..	..
Maimatchin-Kalgan	June 30, 1900 ..	..
Bolama Bissao	July 4, 1901 ..	July 10, 1901
San Domingo landlines	July 9, 1901 ..	July 16, 1901

Telegraph and Telephone Extensions.—The Postmaster-General (Lord Londonderry) has sent, through Mr. J. C. Lamb, a reply to the memorial of the Association of Chambers of Commerce of the United Kingdom in which "the need of a more efficient telegraphic and telephonic service between the commercial and manufacturing centres of the United Kingdom" was urged. Mr. Lamb says his Lordship has recently appointed two experts of great experience to examine the working of the telegraphs at all the larger offices, and to concert measures for effecting any necessary improvements of service. Every endeavour is made to keep pace with growth of traffic, which has been particularly rapid in the case of the telephone trunk service, and a large number of additional trunk circuits have been erected or are in course of construction.

The Cape-Australia Cable.—Mr. J. Euston Squier, acting manager in Australia for the Eastern Extension Telegraph Company, has received a cable message from the London office stating that the laying of the first section of the Cape-Australian cable, between Durban and Mauritius, was completed on 28th inst. The other sections, between Mauritius and Perth, are expected to leave the Thames early in August, and to be laid by the middle of October.

The Pacific Cable.—In the House of Commons on Monday, Sir E. Sassoon asked the Secretary to the Treasury whether he would state to the House, in connection with the Canadian Pacific cable, how much of the material had already been manufactured and delivered, what instalments had been paid, and whether, in view of the provision for the completion of the work by the end of 1902, satisfactory progress had been made towards the fulfilment of the contract. Mr. Austen Chamberlain, in reply, said, according to the *Times* report: "None of the cable has yet been manufactured or delivered, but several cable-houses have been sent out, and are being erected at the several landing places selected. The surveying ship has already sounded the route over a distance of 1,500 miles, and is now engaged on the same work between Norfolk Island and Fiji. The landing places of the cable in Queensland, New Zealand, Norfolk Island, and Vancouver have been decided upon, and preliminary arrangements made for the construction of staff quarters and station buildings. I am informed that the manufacture of the cable begins this week. One instalment of £287,463, due under the contract on March 31st last, has been paid to the contractors. I am informed that the engineers of the Pacific Cable Board are satisfied with the progress made, and with the ability of the contractors to complete the work by the end of 1902."

A Queensland paper, dated May 27th, gives the following news:—"BRISBANE.—The steamer *Britannia*, engaged in connection with the laying of the Pacific cable, left Moreton Bay this afternoon to make a survey between Queensland and Norfolk Island. A test house is to be erected on the island. The vessel will then proceed to New Zealand, taking soundings all the way. A test house is also to be erected in New Zealand, but as the northern point of the island is unsuitable for landing, it is probable that a site will be selected further south. Mr. R. E. Peak, engineer-in-charge, will accompany the vessel. It is hoped that everything will be ready for laying the cable in March next. As that work will not take much time, connection should be made soon afterwards.

The Telegraph System.—In the House of Commons on July 11th, says the *Times* report, Sir J. Leng asked the Secretary to the Treasury, as representing the Postmaster-General,

Whether an intimation recently made to the proprietors of the Sheffield newspaper that the main roads of Post Office telegraphs throughout the country had become so crowded that it is necessary to reserve the remaining space for the public wires which would be required in the immediate future, had been made in view of the recent augmentation in the number of wires by the underground cable to Birmingham and the North; whether the further intimation of the Postmaster-General that his inability to undertake the work would not prevent newspapers obtaining private wires through some other agency than the Post Office mean that the Post Office had finally abandoned its claim to a monopoly of the telegraph service, and that it was now open to promoters to establish a special telegraphic service for the newspaper press; and whether the statement in the "Post Office Guide," dated July 1st, that the Postmaster-General undertook the construction and maintenance on rental terms of private telegraph and telephone wires for firms or private individuals was now annulled, and firms or individuals connected with the Press would be excluded from the rights or privileges common to all others.

Mr. Austen Chamberlain, in reply, said:—

In the communication referred to the Postmaster-General did take account of the fact that there is now an underground telegraph line between London and Birmingham, but the difficulty of finding new routes for new wires has been only slightly lessened by this addition to the Post Office system. The Postmaster-General has never claimed any monopoly of telegraphic communication except that which was granted to him by Parliament in 1869; and the use of a private wire connecting premises belonging to the same person or firm for the transmission of telegrams relating to the business of the owner was not included in the monopoly. There is, therefore, no special reason why the Postmaster-General should provide such telegraphs. A newspaper proprietor is at liberty to erect a telegraph of this kind for himself or to have it erected and maintained by a private contractor; but he is not allowed to establish a telegraphic system for the general distribution of telegrams to the press. The statement in the "Post Office Guide" to the effect that the Postmaster-General undertakes the construction and maintenance on rental terms of private telegraph and telephone wires is not to be regarded as annulled. It is expressly stated in the guide that the rates quoted apply to wires of short length only. What the Postmaster-General finds is that his power to provide long wires is limited by the physical difficulty of obtaining routes; and, in view of this difficulty, he deems it expedient to reserve the available routes for the public service rather than allow them to be absorbed for private purposes. This is of special importance in view of the requirements of the telephone service, as long telephone trunk wires must necessarily be carried above ground. The Postmaster-General still undertakes to provide short private wires. His inability to provide long wires does not apply only to wires for the press, but to all wires of this character.

Wireless Telegraphy.—On 11th inst. in the House of Commons, Sir John Leng asked whether any agreement had been arrived at between the Post Office and the Admiralty to facilitate the use of Marconi's wireless telegraph by British steamships for postal telegraphs and news messages. Mr. A. Chamberlain replied that no agreement had yet been signed, but negotiations were proceeding.

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam.—September 2nd. H.M. Consul at Amsterdam states that tenders are invited by the Municipality of Amsterdam for the supply of "electrical tram-carriages arranged for above-ground supply of electricity, and for about 5,000 tons of grooved rails for tramways, with necessary appurtenances." Particulars may be obtained from the Director of the Municipal Tramways, Nieuwe Achtergracht, No. 164, Amsterdam.

Aston Manor.—July 25th. The Council wants tenders for electrical plant (gas engines and dynamos, motor transformers, switchboard, battery, cables, wiring, &c.), for wiring a fever hospital and a small-pox hospital. See "Official Notices" July 12th.

Blackburn.—July 29th. The T.C. wants tenders for three triple-expansion 775-KW. steam dynamos. See "Official Notices" July 12th.

Blackburn.—July 20th. The Corporation wants tenders for rubber-covered cables for the next 12 months. A. S. Giles, engineer and manager.

Bradford.—July 31st. The Corporation wants tenders for 100 electric cars. See "Official Notices" July 12th.

Brecon.—August 5th. Tenders are invited for electrically lighting the Brecon and Radnor Joint Asylum now erecting at Talgarth. See "Official Notices" June 28th.

Cardiff.—August 6th. The Corporation wants tenders for double-deck bogie cars, four-wheel cars, and single-deck bogie cars; also for switchboard, with instruments. See "Official Notices" to-day.

Dartford.—July 24th. The Council wants tenders for D.C. meters and cut-outs. See "Official Notices" July 5th.

Dundee.—August 5th. The Gas Commissioners want tenders for condensing and cooling plant, electrically and steam driven pumps, feed heaters, &c., for the electricity works. See "Official Notices" July 12th.

Gravesend.—July 30th. The T.C. wants tenders for water tube boilers, piping, engines, dynamos, balancer, boosters, switchboard, mains, lamp posts, battery, meters, cranes, destructor, well and water lifting apparatus. See "Official Notices" July 12th.

Hapton (Lancs.).—July 31st. The Clerk to the Parish Council is inviting tenders for the electric lighting of the township from September next to the following April.

Holland.—September 2nd. The municipal authorities of Amsterdam are inviting tenders until September 2nd next for the supply of 5,000 tons of steel tram rails, with accessories, required for the municipal electric tramways. Particulars may be obtained from, and tenders are to be sent to, Le Directeur des Tramways Municipaux, Nieuwe Achtergracht, 164, Amsterdam.

Ilford.—July 25th. The U.D.C. wants tenders for the electric lighting of the new Town Hall. See "Official Notices" to-day.

Kearsley.—August 1st. The U.D.C. wants tenders for tramway poles, section boxes, overhead line, &c., for 1¾ miles of tramway. See "Official Notices" July 12th.

Kirkcaldy.—July 20th. The Corporation wants tenders for feeders, mains, road work, and arc lamps. See "Official Notices" June 28th.

Lancaster.—July 22nd. The Corporation wants tenders for water tank, electric pumps, condenser, piping, &c., for the electricity works. See "Official Notices" July 12th.

London.—July 23rd. The L.C.C. wants tenders for boilers, pumps, cooking apparatus, and electric lighting installation (exclusive of generating plant) for Horton Asylum. See "Official Notices" July 5th.

Manchester.—August 7th. The Electricity Committee wants tenders for 70 feeder and section pillars for the tramways. See "Official Notices" to-day.

Manchester.—August 14th. The Electricity Committee wants tenders for H.T. switchboards, exciter and auxiliary switchboards for the Stuart Street generating station, also high and low tension boards for sub-stations. See our "Official Notices" July 12th.

Partick.—The Council wants tenders for wiring the electricity supply station. See "Official Notices" to-day.

Pontypridd.—July 23rd. The Guardians want tenders for electric lighting at the Union Workhouse, Infirmary, and other buildings. Particulars from, and tenders to, Mr. W. Speckett, Clerk, Union Offices.

Poplar.—July 24th. The Electricity Committee wants tenders for high tension continuous current transforming plant, and switch gear; also for a year's supply of arc lamp carbons. See "Official Notices" July 12th.

Rochdale.—August 1st. The Corporation wants tenders for poles, bases, section boxes, overhead line, feeder cables, &c., for 5 miles of tramway. See "Official Notices" to-day.

Spain.—July 26th. The Spanish Ministry of Industry and Public Works in Madrid are inviting tenders until the 26th inst., for the construction and working of an electric tramway between El Santuario de la Yedra and the station at Balza (province of Jaen). Particulars may be obtained from, and tenders are to be sent to, El Ministerio de Agricultura, Industria, and Obras Publicas, Madrid.

Spain.—July 30th. Tenders are being invited until the 30th inst. by the Spanish Ministry of Public Works in Madrid, for the construction and working of an electric tramway between Cadiz and San Fernando with a branch to La Carrara. Particulars may be obtained from, and tenders are to be sent to, El Ministerio de Agricultura y Obras Publicas, Madrid.

Spain.—The municipal authorities of Lepe (province of Huelva) have just invited tenders for the concession for the electric lighting of the town during a period of 20 years.

Yarmouth.—July 27th. The Corporation wants tenders for poles, brackets, wire, insulators, overhead equipment and rail bonding; battery, switchboard and booster; also cables and joint boxes, for the electric tramways. See "Official Notices" July 12th.

CLOSED.

Bradford.—The Corporation has accepted an offer of the General Electric Company, Limited, of Manchester, to supply 6,000 16-C.P., 230-volt B.C. incandescent lamps for the total sum of £275.

Glasgow.—The Corporation have accepted the following tenders:—For Meters: The British Electric Meter Company, 200 meters, £440; Messrs. Ferranti, Limited, 400 for £1,306 5s.; Messrs. Chamberlain & Hookham, 680 for £2,221 5s.; British Thomson-Houston Company, 300 for £829 7s.; Reason Manufacturing Company, 100 for £275; also 1,350 Reason Manufacturing Company indicators for £2,216 5s. Tenders from the following have also been accepted:—Messrs. James Ross & Co., coal tar pitch, 29s. per ton; the Falkirk Iron Company, for cast-iron manholes; Callender's Cable and Construction Company, main cables for 12 months; the Craigpark Company and the India-rubber, Gutta-percha and Telegraph Works Company, for rubber-covered and lead-covered cables and flexibles. The Airdrie Iron Company have secured an order for an oil-extracting apparatus for Port Dundas station.

Hackney.—The Council has accepted the tender of Messrs. Mirrlees, Watson & Co., Limited, for coal handling plant at £2,499.

Hendon.—The Coley Electric Works, Limited, of Richmond, have secured the contract for the electric lighting and ventilation of the new municipal buildings.

London.—The Fire Brigade Committee, at a meeting of the London County Council on Tuesday, reported that the following tenders had been received for the supply of an additional engine and dynamo in connection with the proposed extension of the installation at the chief fire brigade station:—

Siemens Bros. & Co.	£950
Crompton & Co.	992
Drake & Gorham	1,031

As the tenders were much in excess of what had been anticipated, the Committee did not see their way to recommend the expenditure. It had, however, been pointed out that some provision should be made so that, in the event of the engine breaking down, the interruption of the lighting would not be of long duration. It seemed to the Committee that this could be provided against "by the purchase of a spare armature." Messrs. Crompton & Co., the makers of the armature now fixed, were prepared to supply a spare one for £87, less 2½ per cent. discount for cash, and it was agreed to accept the company's offer in this respect, instead of one of the before-mentioned tenders.

London.—The Shoreditch Borough Council on Tuesday had under consideration the following tenders received for the supply and erection of high and low tension switchboards, including transformer panels, for the new generating station and according to Specification No. 28:—

Williamson & Joseph, Limited	£4,660
Cowans, Limited (accepted)	5,096
Slatter & Co.	5,470
Johnson & Phillips	6,096
S. Z. de Ferranti, Limited	6,426
Bertram Thomas	6,529
Electric Construction Company	6,842
Crompton & Co.	9,930

The tenders had been referred to the consulting engineers, and upon their advice that of Messrs. Cowans was accepted.

The Council also considered the undernoted tenders for the supply and erection of wrought-steel flues, together with the necessary ironwork in connection with the new generating station in Whiston Street:—

Pierson & Co. (accepted)	£995
W. Jones & Sons	1,070
Mechan & Sons	1,200
Babcock & Wilcox	1,400
Westwood & Wrights	1,939

London.—The St. Pancras Borough Council on Wednesday had under consideration the under-mentioned tenders for the supply of (1) three-phase plant, and (2) feeding mains and arc lighting cables:—

1.—THREE-PHASE PLANT.

The Electric Construction Company, Limited	£13,390 0 0
Johnson & Phillips	11,792 0 0
General Electric Company, Limited	11,303 10 0
Allgemeine Electric Company (accepted)	7,310 0 0
International Electrical Engineering Company	6,660 0 0
British Schuckert Electric Company, Limited	Tenders incomplete.
British Westinghouse Electric Company, Ltd.	
Geipel & Lange	Unable to tender owing to shortness of time.
Siemens Brothers & Co., Ltd.	
S. Z. de Ferranti, Limited	

2.—FEEDING AND ARC LIGHTING CABLES.

	Feeding mains.	Arc lighting cables.	Total
St. Helen's Cable Company, Limited	7,275 0 0	2,881 13 4	10,156 13 4
Western Electric Company	5,925 0 0	2,867 6 8	8,793 6 8
British Insulated Wire Company, Ltd.	5,788 12 9	2,997 16 10	8,786 9 7
W. T. Henley's Telegraph Works Company, Limited	5,656 10 0	2,784 17 2	8,441 7 2
Callender's Cable and Construction Company, Limited (accepted)	5,004 0 0	2,577 18 5	7,581 18 5

Spain.—Contracts have just been let for the establishment of a small electric lighting station in the town of Ayamonte. The dynamo will be driven by a large Fielding & Platt gas engine operated by producer gas.

NOTES.

A Costly Trolley Car.—The *Scientific American* illustrates an elaborate "palace car," which has been built at a cost of $12,000 for Mr. G. F. McCullough, the general manager of the Union Traction Company, of Indiana, by the St. Louis Car Company. The need for this car is easily understood when it is mentioned that the Union Company has a terminal in cities like Indianapolis, Anderson, Muncie and Marion; the system is 140 miles long and competes for traffic with steam roads for most of its length. The presence of the general-manager is required at various centres, and in order to be able to move quickly from place to place, the car was designed so as to afford him an office on wheels, and, if necessary, a home as well. It is 60 ft. long, and there is a cow-catcher on each end of the car. It is mounted on two four-wheel trucks, and is equipped with two 250-H.P. motors, so that it can attain a speed of 60 miles an hour if desired. It is equipped with Christensen air brakes. The equipment, furnishings, &c., of every department, are of the most perfect description, affording a maximum of convenience and personal comfort.

Röntgen Society.—In the Council's annual report we read that Mr. Herbert Jackson, F.C.S., has been nominated as president for the coming session. The report adds, "His early researches in the phenomena connected with X rays place him in the foremost position in this country as an exponent of the subject."

In the communication referred to the Postmaster-General did take account of the fact that there is now an underground telegraph line between London and Birmingham, but the difficulty of finding new routes for new wires has been

for water tank, electric pumps, condenser, piping, &c., for the electricity works. See "Official Notices" July 12th.

The Engineer v. the Electrician.—Mr. J. H. Ryan, jun., of Boston, Mass., writes a letter to the New York *Engineer* under the above heading, and we extract the following therefrom :—"There was a continual kick about the coal bill for four years. At last the engineer told the boss to hand the next coal bill to the electrician, as he had done all that he could. The engineer had charge of the current until it left the switchboard ; the electrician did the rest, renewed all the lamps and did all the new work. The electrician said he would do nothing as he had orders to put them in exactly as they were found to be. The boss said he had to do something, so he put the engineer in charge of the electrical department. This is the load he started in to cut down. From 7 a.m. to 12, 700 amperes ; from 12 a.m. to dark, 2,000 amperes ; from dark to 11 p.m., 2,400 amperes. The first thing he did was to go all over the house, and in every place where he thought that an 8, 10 or 16-C.P. lamp would furnish light enough, if he found a larger one he took it out. Then there are a lot of work rooms and dressing and lunch rooms for the employés, and outside the door of all these rooms he put a cut-out switch, so that when anyone needed light he could have all he wanted and could turn them out when through. Then there were a lot of stained-glass globes with clusters of lamps inside. In most of these he found 25-C.P. frosted lamps. By putting in 8-C.P. plain lamps he got nearly as much light and no one could tell the difference. He put in a separate connection in a lot of chandeliers for one or two lights in each one, then by combining a lot of these and cutting up some other circuits he made a couple of cleaning circuits, and by this and various other ways he cut the morning load from 700 to 250 amperes, the afternoon load from 2,000 to 1,650 amperes, and the night load from 2.400 to 1,850 amperes. This made a difference of about $100 per week in the coal bill. The reason it made so much difference was because the boilers were forced beyond their rated capacity about 100 per cent. After he got the load cut down he got along with one dynamo less and without natural draught on the boilers, and his bills for wear and tear were also less. The electrician was, however, a good man. He could talk about 100,000 ohms and such things by the yard, but he didn't understand the relation between the ammeter and the coal pile."

A Pathetic Case.—The *American Electrician* quotes the following note from the New York *Sun* :—

To the Editor of the *Sun*.

Sir,—The Pan-American Exposition at Buffalo is using so much electricity generated by the power from Niagara Falls, that it seriously affects the atmosphere, weather and climate within a radius of more than 500 miles, causing fearful storms, laying waste towns and villages, sweeping, like the besom of destruction, over whole counties. They are proud of their splendid di-play of electric light, but don't consider that it is the cause of these disasters. Scientists know it. It must be stopped. Revoke the charters; take the cables out of the heavens; stop the dynamos, or take the consequences. Every revolution of a dynamo tends to upset the whole oxygen of the air.

SCIENCE.

New York, *June 10th*.

Our electrical contemporary adds :—"If the persons who merely seek aggrandisement and affluence from electrical development have no more sense of the æsthetic than to hang their cables up in the heavens there is no way to prevent it. but the law should be invoked against the conscienceless mercenaries who upset our oxygen."

Insulation Resistance of Wiremen's Gloves.—A recent number of the *Bulletin de la Société Internationale des Electriciens* contains a paper read by Janet before the Société in Paris, in which the author gives an account of laboratory experiments performed by him in order to find the insulation resistance of different types of gloves for wiremen. The experiments were performed first with the gloves dry and then with them wet, the pressure being 105 volts in each case. In the dry test the gloves were filled with mercury and then suspended in a basin of mercury. In the wet test instead of mercury fine sand moistened with acidulated water was used. The resistance in megohms ranged from zero to 52,500 dry and from zero to 420 wet. The author also made wet tests for determining the effective E.M.F. at which the gloves broke down under high pressure alternating currents. Three of the samples broke down at low voltage, while three others broke down at 1,000, 2,000 and 11,000 volts respectively. In the discussion which followed the reading of the paper it was argued that insulating gloves cannot generally be regarded as an effective protection ; and that wiremen with gloves should not touch the conductors directly, but only such parts as are already insulated.—*American Electrician*.

The National Physical Laboratory.—The executive committee have now made the following appointments :—

Superintendent of the Engineering Department.
T. E. Stanton, D.Sc., Victoria.

Assistants in the Physics Department.
J. A. Harker, D.Sc., Victoria.
A. Campbell, B.A., Cambridge.
H. C. H. Carpenter, M.A., Oxon, Ph.D., Leipzig.

Junior Assistants.
B. F. E. Keeling, B.A., Cambridge.
F. E. Smith, Royal College of Science.

It is expected that one or two more junior assistants will be appointed shortly. The alterations to Bushy House and the new building for the engineering laboratory are well advanced, and it is hoped to commence work early in October. Of the Staff, Dr. Stanton, after serving an apprenticeship with an engineering firm in the Midlands, has had a distinguished career at Manchester and Liverpool, and is now Professor of Engineering at University College, Bristol. His paper on "Surface Condensers," published in the *Phil. Trans.*, is well known to engineers. Dr. Harker and Mr. Campbell have both done work of real value in thermometry and electric measurements ; while Dr. Carpenter, who will have charge of the chemical researches, after a successful course at Oxford, has gained further experience at Leipzig, under Ostwald, and more recently at Owens College. Mr. Keeling obtained a double first in natural science and mechanical science respectively at Cambridge, while Mr. Smith was the most distinguished student of his year at South Kensington, and for two years has been one of Prof. Rucker's assistants.

Cricket.—A cricket match played on Saturday last at Clifton Junction between the Chloride Electrical Storage Syndicate Cricket Club and Glover's Cable Works C.C. ended in a win for the "Chloride" by 56 to 41. J. Atkinson who scored 19 took seven of Glover's wickets for 15 runs.

Technical Education.—The Technical Education Board of the London County Council on Monday directed the Higher Education Sub-committee to inquire and report (*a*) as to the need and present provision for special training of an advanced kind in connection with the application of science, especially chemistry and electricity, to industry ; (*b*) as to what, if any, developments are needed to secure efficient training in these subjects for senior county scholars and other advanced students who desire to qualify themselves to take leading positions in scientific industries.

Accident at Herne Bay.—For some time past a third-rail line has been in operation along the Pier at Herne Bay. On Tuesday of this week a serious accident befel a train of three coaches having a motorless luggage conveyance attached to its fore end. This "trolley," as it is called, seems to have left the metals, crashed through the side of the pier, and fallen together with the first of the three coaches into the sea. There were four passengers in the coach, and after the car had turned a somersault they were precipitated in the sea. They were promptly rescued, but the shock killed a lady passenger of 74 years of age. The inquest was held the same day, and the jury returned a verdict of "Accidental Death," adding that the pushing of the trolley *(sic)* in front of the train should be discontinued as unsafe.

The Edison Battery.—The *Scientific American* says that a company has been formed to manufacture the new storage battery invented by Thomas A. Edison, which will be known as the Edison Storage Battery Company. The new company will proceed at once to enlarge the factory of Mr. Edison, at Glen Ridge.

(*Continued on page* 110.)

should be made so that, in the event of the engine breaking down, the interruption of the lighting would not be of long duration. It

exponent of the subject."

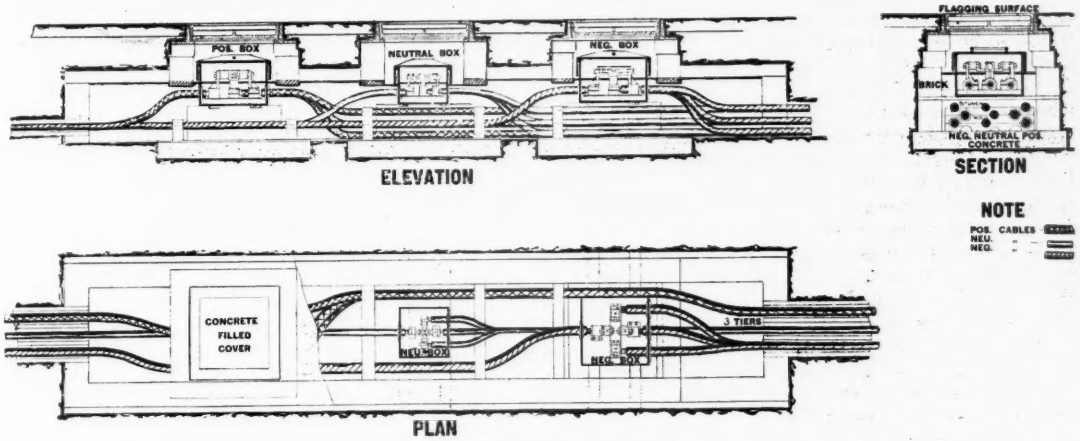
ELECTRIC POWER SUPPLY ON TYNESIDE.

(*Continued from page* 62.)

Underground Mains.—The contract for the supply and laying of all the Gas Company's mains, together with the roadwork, boxes, &c., in connection therewith, was placed in

Board of Trade regulations for working at 5,500 volts effective, even with no point earthed.

The cables are then covered with a heavy tube of lead, and are laid on the solid system in cast-iron troughs supported on wooden bridges, and run in with Trinidad bitumen. The trough is finished by a wrought-iron lid consisting of ¼ in. plate, so as to give the greatest



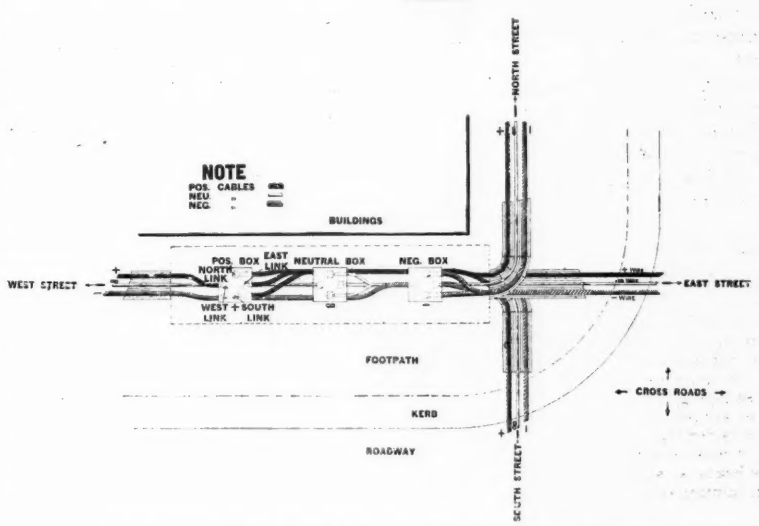
Arrangement of 4-way Boxes.

he hands of the Callender Cable and Construction Company, Limited.

Two essentially different types of mains are employed, namely: (1) Three-core cables intended to be used on the three-phase circuits; (2) single-conductor cables separately insulated, each one laid by itself on the solid system for low pressure direct current.

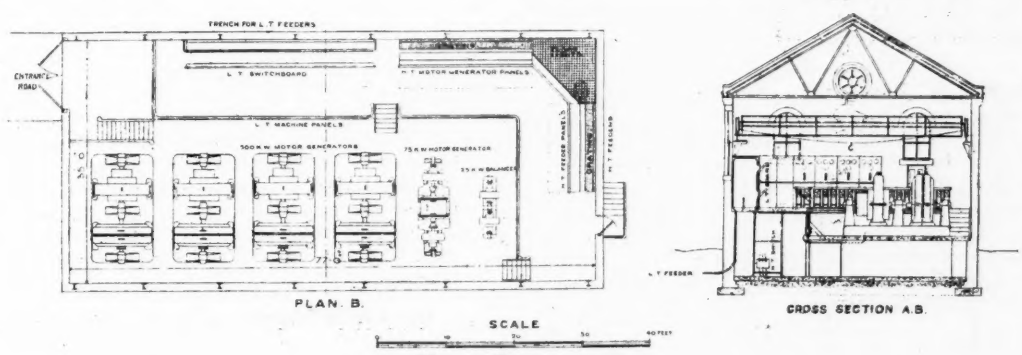
The three-phase mains consist of a series of three-core cables, each branch having a sectional area of ·15 sq. in., insulated by bitumenised paper. The three cores are stranded together and wormed circular, and on the cable thus formed there is an additional thickness of bitumenised paper, so as to bring up the wall of

possible mechanical protection against injury from the outside.



Arrangement of 4-way Boxes and Cables at Street Corners.

In order to reduce the possibility of interruption to a minimum, two distinct lines of high pressure mains are run from the power house in separate trenches throughout. One three-phase main goes direct to the sub-station at the North-Eastern Marine Company's yard; a similar main is carried to the sub-station at the Tynemouth end of the district; whilst a third main is laid with connections to both these sub-stations, so that it can supply current from the generating station to either or both, or be used as an interconnecting main between the two sub-stations.



Manors Sub-station.

dielectric to the same radial thickness between any conductor and earth, as between the conductors themselves.

The cables thus made are designed to comply with the

Spare ways are laid wherever high pressure mains are put down, and in addition there is a service of telephone and test cables, so that any sub-station is in immediate

E.M.F. at which the gloves broke down under high pressure alternating currents. Three of the samples broke down at

Glen Ridge.

(*Continued on page* 110.)

communication with headquarters and with its neighbour.

The low pressure network consists of the Callender Company's standard make of vulcanised bitumen cable. The mains are three-wire, consisting for the greater part of addition to this line there is a network of similar low pressure mains in the Willington Quay District, and connection is made between the networks by means of vulcanised bitumen feeders.

There are several branch distributors of smaller section.

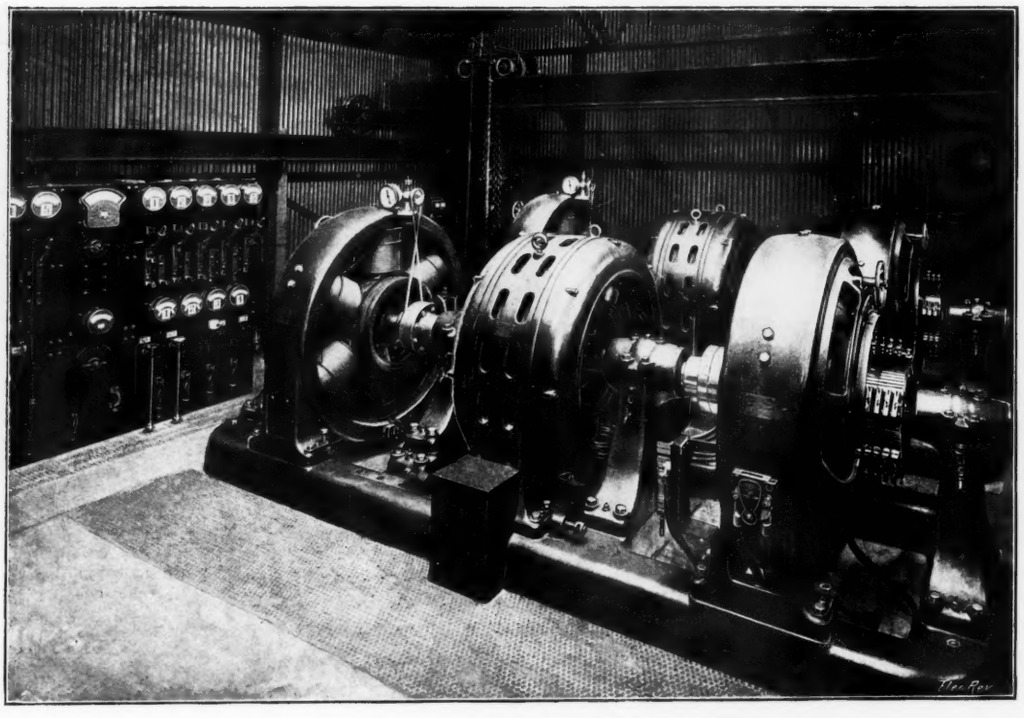
Laying Earthenware Pipes for Callender Mains.

Laying Callender Three-Phase Mains in Earthenware Troughs.

·5, ·25, ·5 sq. in. distributors, but in some cases ·5, ·5, ·5 sq. in. is used. Each cable is laid in an earthenware trough by itself, supported on bitumenised wood bridges, and run in solid with Trinidad bitumen, being completed by a covering of hard bricks which are set in the molten bitumen.

Practically speaking it may be said that the system is laid out so as to supply any of the factories with current at either high or low pressure, as they may wish.

A series of iron pipes has also been laid along the North-Eastern Railway between the power house and Messrs.



No. 1 Sub-station, Containing two 300-kw. B.T.H. Motor-Generators.

These low pressure mains run from the generating station along the Hadrian Road to the North-Eastern Marine Sub-station. They are also laid in Station Road, Wallsend, and along the High Road, looping back into the main distributing line between the power house and the sub-station. In

Armstrong's, for the purpose of supplying them and others with high pressure three-phase current.

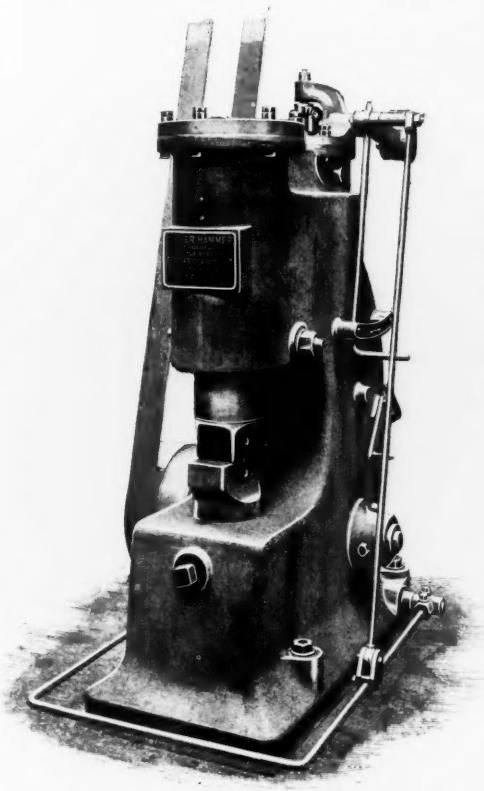
Briefly put, this is a description of the feeder and distributing network in the Walker and Wallsend District; but in addition to this the Callender Cable Company are now

dielectric to the same radial thickness between any conductor and earth, as between the conductors themselves.

The cables thus made are designed to comply with the

Spare ways are laid wherever high pressure mains are put down, and in addition there is a service of telephone and test cables, so that any sub-station is in immediate

busy with the construction of a heavy trunk line to connect the generating station at Neptune Bank with Newcastle City.



Electrically-Driven Pneumatic Power Hammer.

Their contract provides for the construction of a conduit having nine ways, each 4 in. in diameter, consisting of

three-phase mains laid in the Walker district, but the sectional area of conductor in each branch will be considerably larger, being ·25 sq. in., whilst over the lead cover there will be a sheathing of steel wires so as to comply with the new requirements of the Board of Trade as to the conductivity of the metallic sheath. The trunk main conduit in

B.T.H. 50-kw. Transformers in Armstrong, Whitworth & Co.'s Sub-station.

question starts at the generating station at Neptune Bank, and runs *viâ* Walker Road, through Walker, to the sub-station at the end of Byker Bank. It proceeds thence to the sub-station at Manors, where Messrs. Callender's contract terminates. From a point in this main between Ouseburn and Manors, the British Insulated Wire Company have a similar contract to carry a line of transmission ducts and cables to Vandon Dene and Jesmond sub-stations. The B.I.W. meet the requirements of the Board of Trade by providing a layer of copper tape under the lead instead of having, as in Callender's case, an outer layer of steel wires.

High Pressure and Low Pressure Switchboards in No. 1 Sub-station.

specially made stoneware pipes set in a solid block of concrete, into which three-phase cables will eventually be drawn. These cables will be in many respects the same as the

These are to act as trunks for the supply of current required in Newcastle City, and except at the various sub-stations it is not intended to be tapped or interfered with.

station. They are also laid in Station Road, Wallsend, and along the High Road, looping back into the main distributing line between the power house and the sub-station. In

Briefly put, this is a description of the feeder and distributing network in the Walker and Wallsend District; but in addition to this the Callender Cable Company are now

Throughout the whole of the work, on both contracts, great care has been taken in regard to the manholes and drawpits. On the Wallsend and Willington line, owing to the difficulties met with and the nature of the subsoil, and the fact that the mains are in the roadways, these are practically small underground chambers. The mains forming the Newcastle trunk line are all laid under the footpath, and consequently the manholes are not quite so deep. They have been constructed with the view of making it possible to handle the heavy trunk main cables and connect them up as readily as is possible, and although they form an item of considerable expense in the total work, they are probably the best examples of manholes on a heavy drawing-in system which have ever been constructed in this country.

The boxes joining the factory length of high pressure mains are designed so that there shall be complete continuity of the wire sheathing. They are of a type which has been proved satisfactory in practical working at Wallsend among other places.

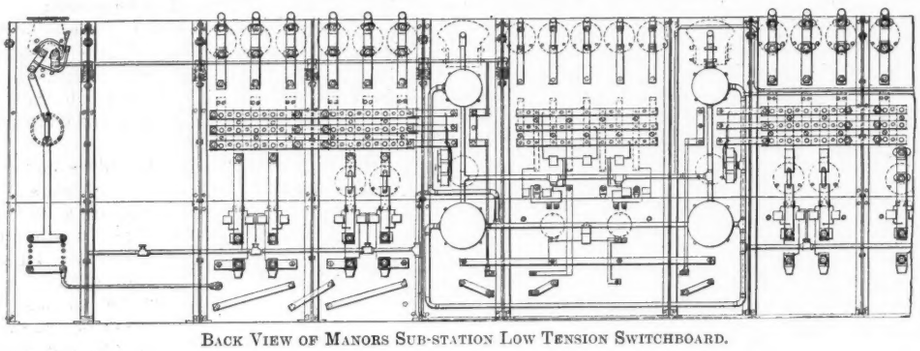
The whole of the Newcastle low pressure distributing network consists of Callender's single-core vulcanised bitumen cables, each laid in a separate chase of an earthenware trough, which is filled up solid with bitumen, and covered with tiles.

The troughing used throughout is of the three-chase socketted type, and small earthenware service boxes are placed over this, and filled up solid wherever a service connection is made.

The disconnecting boxes used are of Callender's Cork type, fitted with diving bell cover.

The feature in the whole of the boxes in Newcastle and its district is the interchangeability of all parts, everything being made to template, and as few types as possible being adopted.

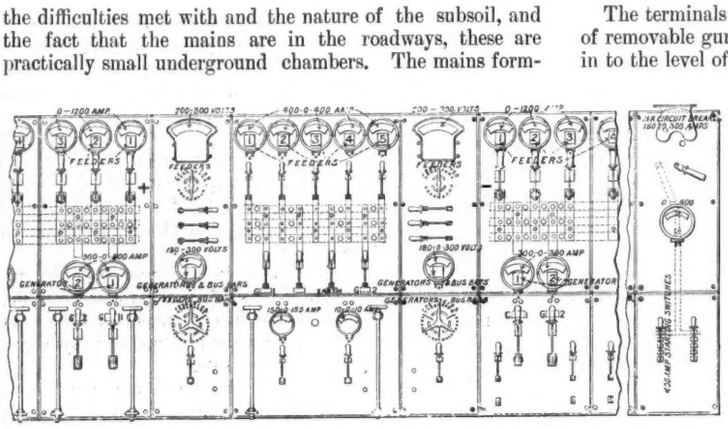
Cables of one polarity only are brought into each box, the risk of serious short circuits being thus avoided. No fuses are used in any part of the network, but the whole is solidly connected to the sub-station.



Back View of Manors Sub-station Low Tension Switchboard.

The terminals are all connected to a centre block by means of removable gun-metal links, and bitumen compound is run in to the level of the underside of the links.

The box is provided with a cast-iron cover, to which is applied the principle of the diving bell, and is arranged to withstand a pressure of water due to a head of upwards of 6 ft., without being fastened down in any way, except by its own weight. The general arrangement of these boxes can be seen on the accompanying plans.



Front View of Manors Sub-station Low Tension Switchboard.

Main Sub-stations.—As the three main sub-stations are designed for an eventual equipment of 2,000 KW., and are all of practically the same design, a description of one of them will suffice. The following is a description of the Manors sub-station, shown on the accompanying plan:—

This is an iron building, with the roof principals supported on rolled steel columns. The walls are of brick, but are not intended to take the weight of the structure. The basement is at road level; the machines rest on concrete foundations, which rise to a height of 6 ft. above the basement. The switchboard gallery is 4 ft. above the machine floor.

Sub-station and Overhead Lines in Messrs. Armstrong, Whitworth & Co.'s Shipyard.

specially made stoneware pipes set in a solid block of concrete, into which three-phase cables will eventually be drawn. These cables will be in many respects the same as the

These are to act as trunks for the supply of current required in Newcastle City, and except at the various sub-stations it is not intended to be tapped or interfered with.

A well is provided at the entrance door, where the machinery is brought in, and a "traveller" runs the whole length of the building, whereby material can be carried to any part of the sub-station on either the machine floor or the switchboard gallery. This arrangement of levels permits of great simplicity in running the leads both from the machines and from outside. This will be considered further on.

The initial equipment consists of two 500-KW. synchronous motor-generators; one 75-KW. asynchronous balancing and starting set; one 25-KW. continuous current balancer; high tension switchboard; low tension switchboard; and one 5-ton travelling crane.

Sub-station Motor-Generators.—The large motor-generators for the sub-stations in Newcastle are being supplied by Messrs. Richardsons, Westgarth & Co., Limited, manufactured by Brown-Boveri, of Baden, and two—the first instalment for one of the sub-stations—by the British Thomson-Houston Company, Limited.

Each set will consist of one three-phase synchronous motor, wound for the full pressure of 5,500 volts, coupled to a single continuous current generator. The two machines of each set are mounted on one bedplate. The motor has a fixed armature and revolving field, and the armature winding is star connected. The full load output of each continuous current set is 980 amperes at 510 volts, and the three-phase motor is so designed that by means of a field rheostat the power factor at full load can be varied from 1 to ·8, the wattless current being a leading current. No part of the apparatus, except the commutators, in continuous running at the full load will rise in temperature more than 40° C., as measured by thermometer, and no part of the commutators will rise in temperature more than 45° C. The motor-generators will be capable of running for one hour at an overload of 25 per cent. without excessive rise of temperature in any part, or injurious sparking, the position of the brushes being fixed for all loads.

The efficiency is guaranteed to be not less than 89 per cent. at full load; 87 per cent. at two-thirds load; 78 per cent. at one-third load.

Sub-Station Switchboards.—The high pressure switchboards are being supplied by Messrs. Richardsons, Westgarth and Co, Limited. Each switchboard consists of a feeder board and a motor-generator board, which are placed at right angles, and are connected through a panel which will contain wattmeters and power factor indicators dealing with the total power being taken by the motor-generators.

Each board is constructed of angle iron and marble slabs, and consists of two parts, a lower frame and an upper frame. The lower frame is located beneath the floor of the switchboard gallery, and contains the high pressure bus bars, switches, fuses, and instrument transformers. The upper frame contains the rheostats, indicating instruments, and handles for operating the main switches. The latter are of the oil-break type, and are geared to the operating handles by means of chains and sprocket wheels. All the instruments, both voltmeters and ammeters, are operated through transformers. The whole of the high pressure parts are kept below the floor, and thus safety in ordinary working is secured, since all high-pressure parts are inaccessible to the operator on the gallery.

The low pressure switchboards are being supplied by Messrs. A. Reyrolle & Co., Limited. Each board is divided into three portions, viz., positive, negative, and neutral, which are separated by two voltmeter panels. There are three sets of horizontal bus bars, and any generator, balancer, or feeder can be connected to any of the three sets of bus bars by means of the usual arrangement of vertical bars and screw plugs. The board is designed for ultimately dealing with four 500-KW. motor-generators, two balancers, and nine feeders, some of which will be interconnectors between sub-stations. For starting the synchronous motor-generators, an extremely neat and simple arrangement of switches is provided, by which any motor-generator can be connected with a special starting panel, which is fitted with starting resistances and an automatic cut-out, and is located at one end of the low pressure switchboard. The backs of the voltmeter switches are covered in with neat brass cases, and all voltmeter wires are run in metal tubing, thereby securing a neat and safe arrangement on the back of the board. The dynamo fuses and field switches are located on panels fixed on the wall supporting the switchboard gallery.

Light is admitted into the basement by means of glass area lights, let into the gallery floor in the corner between the high and low pressure switchboards.

The arrangement of cables in the sub-stations is exceedingly simple, and crossings are avoided as much as possible by running all the high pressure leads from the machines along the basement floor, direct into the dividing boxes of the high pressure switchboard, which are also placed on this floor.

The low pressure machine cables, on the other hand, are fastened by means of porcelain insulators to the underside of the machine floor, and are connected to the fuses provided on auxiliary machine panels placed on the low wall directly below the low pressure switchboard. These panels are also equipped with field breaking switches.

The leads which connect the auxiliary panels with the main board run on the underside of the switchboard gallery floor, and are taken direct to the corresponding lugs on the machine switches.

Both high and low pressure feeders drop down into iron bends and thence pass out of the sub-station. All interconnecting cables are treated in the same way as the feeders, the only difference being that in the case of the low pressure the ammeters are centre reading, so as to indicate both incoming and outgoing current.

All the sub-stations are in direct telephonic communication with one another and with the power station, and should a breakdown occur in any one of the former, its load may be taken by another by means of the above-mentioned interconnectors.

A sub-station is started up in the first instance on the high pressure side by means of the asynchronous motor-generator, which makes the direct-current bus bars alive; the synchronous motor-generators are run up to synchronism by motoring the direct current side.

When these have attained their speed, and have been duly synchronised with the high pressure feeders, the asynchronous motor is shut down, and the direct-current machines may run as balancers.

The sub-stations are also equipped with air compressors, as is the power house; the lighting is done by means of Angold enclosed arc lamps, which are trimmed from the crane. Gas and water are laid on, and lavatory accommodation is provided.

System of Supply.—In addition to supplying manufacturers with power, the companies have undertaken to instal all apparatus which may be required for power or lighting purposes, free of first cost to the consumer, charging an annual rental based on the capital cost to the company of providing and installing the plant. In this way manufacturers are relieved from having to go to any great expenditure, and at the same time are freed from all trouble and responsibility in connection with the various branches of the work.

For an additional sum per annum the companies are prepared to do all maintenance in connection with the installations—renewing bearings, adjusting brushes, trimming arc lamps, &c., and keeping the installation generally in good working order.

Owing to the great variety of the manufacturers' requirements which the companies are called upon to supply, difficulties have been met with which have made it impossible to adopt one system of supply throughout, and also have rendered it difficult to standardise the apparatus used. Where the matter was left to the companies' engineers, as is the case in most of the yards, they recommended the three-phase system, especially for all constant speed work, but as some of the manufacturers prefer direct current, arrangements have been made for supplying current on one or other or both of these systems, as may be required.

On account of the quantity of direct current required, and the fact that it is more suitable for arc lamps, direct current distributing mains had to be laid throughout most of the district along the river side. This being so, it was found to be convenient to do all lighting on this system, and thus avoid the necessity of keeping the three-phase voltage constant within 1 or 2 per cent., the direct current being supplied through motor-generators.

The question of delivery was also a factor which affected

being adopted.

Cables of one polarity only are brought into each box, the

which rise to a height of 6 ft. above the basement. The switchboard gallery is 4 ft. above the machine floor.

the make and class of apparatus used, as negotiations with the individual manufacturers extended over a considerable period, and immediately a settlement was come to it was usually necessary to get their works changed over as speedily as possible.

Special designs have now, however, been got out, and the following apparatus standardised for use in the various installations:—High pressure feeder and transformer panels, low pressure transformer and circuit panels, direct current feeder, power and lighting panels, direct current motor starting panels, distributing boxes, switches, winch motors, arc lamps, and all lighting fittings.

One of the difficulties which arose when taking up the question of electric power with some of the manufacturers was the fact of their having steam hammers, on account of which they were not able to dispense entirely with boiler power. This difficulty will, it is hoped, be surmounted by substituting pneumatic power hammers in place of those at present driven by steam.

As has been previously stated, the power is supplied at a pressure of 5,500 volts, and for the purpose of reducing this to the working pressure of 440 volts, separate sub-stations have been provided in those works which are too far distant to allow of their being supplied with low pressure currents from one of the main sub-stations. Each sub-station is in direct telephonic communication with the power house.

The companies are now supplying power to a number of the largest shipyards and engineering works on the north side of the Tyne, in the majority of which the power is supplied on the three-phase system. Below we give, in brief, particulars of the arrangements which have been carried out in sub-station No. 1, and in some of the various yards in which the installation has been designed by the company's engineer.

No. 1 sub-station (near Messrs. The North-Eastern Marine Engineering Company's works).

Two motor-generators, built by the British Thomson-Houston Company, Limited, receive three-phase alternate currents, and deliver direct current to a 500-volt three-wire network. Each set consists of one synchronous motor, wound for 5,500 volts, direct coupled to two direct-current machines, one at either end. The output of each machine is 150 KW. when running at 400 revolutions per minute, giving at full load 265 volts as shunt machine, 257 as compound. The combined commercial efficiency at normal full load is not less than 87 per cent. The temperature rise, after 10 hours' run at full load, does not exceed 40° C. above the surrounding air, as measured by the thermometer.

The high pressure switchboard, by Messrs. Ferranti, Limited, consists of five panels, three feeder, two motor-generator. Each panel contains one ammeter, three switches, and three fuses. Duplicate synchronising gear is mounted on the board. Any one panel can be disconnected from the bus bars whilst alive, by using insulated tools.

The low pressure switchboard, by Messrs. Reyrolle & Co., consists of seven panels, one positive, negative, neutral, two test, and two starting.

The main board has machine switches and ammeters at the bottom, feeder and distributing mains at the top.

This sub-station is provided with a 7½-ton travelling crane, manufactured by Messrs. Morris & Bastert.

Messrs. Sir W. G. Armstrong, Whitworth & Co.'s Walker Shipyard.

Sub-station.—High pressure switchboard, by Messrs. Ferranti, Limited; four panels—two feeder and two transformer—each panel equipped with one ammeter, three switches, and three fuses. Low pressure switchboard, by Messrs. Reyrolle & Co.; seven panels—two transformer, one meter, four three-phase circuit—transformer and three-phase circuit panels equipped with three fuses, one ammeter and triple pole switch. Transformers by the British Thomson-Houston Company; seven, each 50 KW., single-phase, ratio 5,500 to 440 volts, six in use and one spare. These are connected up delta-fashion, so that failure of one does not stop the supply. The efficiency at full load is not less than 97 per cent.

Motors of the British Thomson-Houston Company's three-phase induction type. Three kinds are used, one having a short-circuited rotor, the others former-wound rotors. The former are started by combined oil break switches and compensators. Of the other types, one has a resistance mounted inside the rotor itself, which is cut out by means of a sliding handle passing through the hollow rotor spindle; the other is provided with slip rings, and is used in conjunction with a controller for variable speed purposes.

Distributing Boxes of cast-iron, specially designed; these are made in different sizes, suitable for taking from three to nine panels each, and are equipped with either power or lighting circuit panels, according to requirements, the overall dimensions of the various classes of panel being identical. To guard against risk of a short circuit in a power distributing box, *i.e.*, boxes equipped with fuses of over 5 amperes capacity, single-pole boxes are used.

(To be concluded.)

NOTES.

(*Continued from page* 104.)

Labour Troubles in the States.—While we have little sympathy with the American steel strikers in their alleged grievances, we cannot help experiencing slight feelings of gratification that manufacturers in the States, who imagined they were going to carry all before them, are to be subjected to troubles similar in character to those which have for many years harassed the British manufacturer. In the absence of exceptional causes, it looks as though labour troubles are not so black a cloud on the horizon of English engineering and iron and steel trades as they have been at various times during the past decade. But not so with America, where the recent movements of trust founders and multi-millionaires have led the working classes, as we call them, to look to their position under the new organisations. If the strike continues, European manufacturers may benefit, very much in the same manner as German and American firms did by reason of the English engineering strike. But we hope it will never be written down against us that we helped to maintain the American strikers by sending them financial assistance. That engineering strike set our old country back a little way in industrial and commercial matters. If the American is to be subjected to the same dictatorial policy as the autocratic trade union leaders in England have tried to impose—though unsuccessfully—is it to be expected that our trans-Atlantic friends will pass through the fire unsinged? To our mind that saying is very near the mark that America is at the beginning of her labour wars, while, after lengthy struggles, English masters and men seem to be understanding each other better. As the *Times* New York correspondent remarks, the question of the present steel struggle is not of wages or hours, but whether the men who own the mills shall manage their own property and business. On this point English masters have adopted a firm attitude, but there are already indications that American employers are wavering. We may excusably remark that if they are controlled in this matter, there is no knowing whither their men will lead them.

Electric Tracto-Neuralgia and a Cure.—Far be it from us to attempt to deal with all the critical effusions which are appearing in the newspaper press just now with reference to the new system of electric trams in West London; but there is one which is so intensely amusing that we cannot help quoting a remark contained in it. The letter says that "my doctor is attending six shopkeepers in this thoroughfare (Chiswick High Road), all of whom are suffering from acute neuralgia, caused by the incessant noise and the proximity of a powerful electric current." The Chiswick doctor might recommend his neuralgic six to try a new cure, known as "Electrites, the great invigorator." We ought to mention that electrites are small discs, a combination of copper and zinc, which have to be worn in the heel of each stocking (or sock we presume). These are said to be excellent things for curing "lassitude, nerves and rheumatism," and you may wear them "the whole day without the slightest inconvenience" and they last for two years. Their cost is only 1s. 6d. a pair. The wholesale vendors of these appliances, which "strike at the root of practically every illness," have apparently forgotten the lesson of the Harness electropathic belt. Perhaps a gentle reminder may be beneficial!

are run in metal tubing, thereby securing a neat and safe arrangement on the back of the board. The dynamo fuses being supplied through motor-generators.

The question of delivery was also a factor which affected

The Manchester Fatality.—We referred last week to a fatal accident which occurred to a linesman named Horne in the Manchester Corporation's tramway department, who, while altering certain frogs, received a shock from a wire, and fell, sustaining fatal injuries. The inquest was held last week. The evidence treated at length of the question whether deceased knew of the danger in which he stood by touching the wires referred to. The jury returned a verdict of "Accidental death," and a juryman suggested that each workman in the department should be questioned as to his knowledge of the danger which surrounded his occupation.

East Ham Electric Tramways.—Last night the electrical system which has been laid down by the Council was inaugurated with the customary public ceremonial.

Southend-on-Sea Electric Trams.—The electric trolley system which has been equipped by the Southend Corporation was inaugurated yesterday (Thursday) evening.

More Trusts.—The *Morning Post's* New York correspondent telegraphs that the Gould interests are reported to be forming a huge trust to control all the telegraph and telephone lines in the country, and to buy up the several cable companies whose lines run from the United States to Europe. "It is announced that if the deal is arranged rates and tolls will be reduced at least one-fourth."

Glasgow.—The autumn meeting of the Iron and Steel Institute will be held in Glasgow concurrently with the International Engineering Congress.

London University.—Prof. Rucker has been appointed Principal of this University, and Mr. Percy Wallace, M.A., secretary to the Senate.

Marriage.—On July 15th at North Shields, Mr. A. Hugh Seabrook, engineer at the Electricity Supply Works, Barking, was married to Miss Edith Strachan, of North Shields.

An Electrically-steered Balloon.—At Monday night's meeting of the Aeronautical Society, Mr. P. J. Alexander exhibited to the audience assembled at the Society of Arts a device for steering a balloon by electric waves.

Naval Boilers.—The *Minerva*, fitted with cylindrical boilers, is said to be in excellent condition; the *Hyacinth* fitted with Bellevilles, had to put in at Gibraltar before her time, in consequence of the "bursting of a feeding boiler pipe."

City and Great Northern Railway.—The directors are stated to be at present engaged in the examination of tenders for electric locomotives.

Obituary.—We regret to announce the death of Mr. Whiteley, of Wm. Whiteley & Sons, Limited, Prospect Iron Works, Lockwood, Huddersfield, who passed away on the 8th inst., aged 51 years.

Personal.—Mr. F. Crew has resigned his position as city representative of the Edison and Swan Company, where he has been engaged for so many years, and is now acting as London representative for Messrs. Evered & Co. in their electrical department.

Mr. Ivan F. Fawcett, of St. Pancras electricity department, has been appointed wiring instructor to the Battersea Polytechnic.

Mr. Edgar C. Thrupp, A.M.Inst.C.E., has opened an office at 39, Victoria Street, Westminster, where he will practice as a consulting engineer. For 19 years he was with Prof. Henry Robinson, for 15 years acting as chief assistant, in which capacity he had to do with the designing of various electric lighting plants, and civil engineering works.

Appointments Vacant.—An electrical engineer is wanted for the Rainhill County Asylum. A junior assistant electrical engineer is wanted for the Woolwich electrical department. The Salford Corporation wants an assistant electrical engineer. A demonstrator in electrical engineering is wanted for the South-Western Polytechnic, Chelsea, at £120 per annum.

Telephone Distributing Boxes.—In reply to "Cable Jointer," Messrs. W. T. Glover & Co., Limited, write:—"Diatrine compound has been used for filling joint boxes during the last five years. It does not shrink after cooling, it is not brittle, and it absolutely prevents moisture from creeping to the fittings. Its insulation and pressure resistances are high, and it is manufactured by us."

Change of Address.—Messrs. G. Boor & Co. have removed their offices to 39, Mincing Lane, E.C. The Warehouses will remain at Artillery Lane.

NEW COMPANIES REGISTERED.

Frinton-on-Sea and District Electric Light and Power Company, Limited (70,689).—This company was registered on July 1st, with a capital of £5,000 in £1 shares, to carry on the business of an electric light company in all its branches, to construct, lay down, establish, fix and maintain cables, wires, lines, accumulators, lamps and works, to generate, accumulate, distribute and supply electricity, to apply for and carry out provisional orders and licenses under the Electric Lighting Acts, 1882, 1888 and 1899, or similar statutes, to promote other companies and to manufacture and deal in electrical apparatus, &c. The first subscribers (each with 50 shares) are:—W. Webster, 50, Lee Park, Blackheath, S.E., electrical engineer; W. Hayne, 3, Station Road, Frinton-on-Sea, Essex, architect; G. D. Collins, A.M.I.C.E., Elektron, Old Road, Frinton-on-Sea, electrical engineer; P. Collins, 81—3, Cheapside, E.C., insurance broker; Samuel Davis, 10, Draper's Gardens, E.C., stockbroker; Sydney Davis, Raymead, Frinton-on-Sea, stockbroker; and R. N. Sherwood, 51, Finchley Road, Kennington Park, S.E., clerk. The number of directors is not to be less than three nor more than seven; the first are not named. Qualification, £100; remuneration as fixed by the company. Registered office, 6, Old Jewry, E.C.

Electro-Carbide Lamp Syndicate, Limited (70,736).—This company was registered on July 5th, with a capital of £200 in £1 shares, to acquire patents and inventions relating to incandescent electric filaments, electric lamps and electric globes, or any interest therein, and to carry on the business of electric lamp, globe and fittings manufacturers, electrical and general engineers, suppliers of electric light, electricians, &c. The first subscribers (each with one share) are:—J. C. Crawford, 17, Stratton Street, W., gentleman; A. J. Kent, 8, Cross Road, S. Wimbledon, accountant; J. W. Percival, 42, Durlston Road, Kingston-on-Thames, gentleman; R. S. Garwood, 35, Chestnut Avenue, Walthamstow, shorthand writer; R. Campbell, 2, Glaskin Street, Hackney, N.E., clerk; J. Douglas, 58, St. Kildas Road, Stoke Newington, clerk; and W. M. Scrivener, 2a, Dryburgh Road, Putney, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first.

SUPPLY STATION ACCOUNTS.

Chester Corporation Electricity Accounts.

THE Chester Corporation accounts indicate a continuance of the excellent state of affairs we have more than once commented upon. The last four years' results are summarised:—

Year.	Units sold.	Average price.	Total cost.	Gross profit.	Net profit.	Public lamps.
1897	355,957	4·50d.	2·32d.	£3,358	£1,014	85 arc
1898	473,656	3·77d.	1·52d.	4,658	1,899	116 arc 120 inc
1899	617,792	3·60d.	1·79d.	4,999	1,206	165 arc 206 inc
1900	780,567	3·42d.	1·86d.	5,443	1,437	165 arc 313 inc

The figure given for maximum load may be a misprint in the accounts, otherwise it indicates a desirable improvement in the load factor. More capital than previously was expended during the year, and the output increased by a larger amount than has been the case before.

GENERAL STATEMENT.

	1899.	1900.	Inc.
Total capital expenditure ...	£65,766	**£83,542**	£17,776
Number of units sold	617,792	**780,567**	162,775
Total maximum demand KW. ...	529	**527**	−2
Gross revenue	£9,607	**£11,502**	£1,895
Gross expenditure...	£4,608	**£6,059**	£1,451
Gross profit	£4,999	**£5,443**	£444
Average price per unit sold ...	3·60d.	**3·42d.**	−·18d.

The revenue, although slowly falling per unit, has not been unduly diminished by rushing prices down. The reductions during the past three years have been ·71d., ·15d. and ·19d. The prices charged are 4½d. and 2½d. per unit.

having a short-circuited rotor, the others former-wound rotors. The former are started by combined oil break

electropathic belt. Perhaps a gentle reminder may be beneficial!

Revenue Statement.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£9,268	3·60d.	£11,110	3·42d.	−·18d.
Meter rents	251	·10d.	310	·09d.	−·01d.
Sales and repairs of lamps and other apparatus	88	·03d.	82	·03d.	·00d.
Sundry fees	—	—	—	—	—
Gross revenue	£9,607	3·73d.	£11,502	3·54d.	−·19d.

Coal is steadily rising in the cost sheet, having been ·3d. in 1898, ·45d. in 1899, and ·63d. last year, but the increase in the price of fuel entirely accounts for this. Repairs are now stationary. The effect of economies in other items than fuel has been to lessen the effect of the coal bill and to leave the total cost at a figure of just over 1¼d., which is certainly creditable to Mr. F. Thursfield, the engineer.

Cost of Production.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal, and unloading same	£1,155	·45d.	£2,043	·63d.	+·18d.
Oil, waste, water and engine room stores.	306	·12d.	369	·11d.	−·01d.
Salaries and wages incurred in generation and distribution, and attending public lamps.	1,157	·45d.	1,597	·49d.	+·04d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and renewals, &c., of street lamps.	847	·33d.	1,046	·32d.	−·01d.
Works costs	£3,465	1·35d.	£5,035	1·55d.	+·20d.
Rent, rates and taxes	149	·06d.	152	·05d.	−·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	723	·28d.	526	·16d.	−·12d.
General establishment charges, stationery and printing, law charges and insurance	271	·10d.	326	·10d.	·00d.
Other expenses	—	—	—	—	—
Total costs	£4,608	1·79d.	£6,059	1·86d.	+·07d.

The increase in revenue exceeded the increase in costs by £444, against which there were augmented financial charges of £213. The difference has brought the net profit up from £1,206 to £1,437, of which latter sum £1,314 has been taken to the reserve fund and £123 carried forward to form a cover for possible bad debts in the current year. Chester has not been led away by the tempting bait of reduction of rates, but has consistently transferred surplus money towards wiping off preliminary expenses or building up a reserve against future contingencies, to meet which there is now a sum of £3,896.

Profit Statement.

	1899.	1900.
Interest on loans	£1,890	£2,103
Sinking fund for repayments	1,903	1,903
Net profit carried to reserve fund	1,140	1,314
„ „ forward	66	123
Gross profit	£4,999	£5,443

Bury Corporation Electricity Accounts.

The financial position disclosed by last year's accounts of the electricity supply department of the Bury Corporation is not so favourable as would have been anticipated from the previous year's results. Fuel and special repairs caused the costs to swell, and a large bank overdraft bearing interest at the high figure of 5 per cent. accounts for the rapid increase in financial charges with augmented capital expenditure of only £5,585. The plant has been extended by the addition of a 360-H.P. Belliss-Siemens set. The generating plant is now equivalent to that required to supply 30,000 8-C.P. lamps connected to the mains, assuming half of the sets be used at any one time Early last year the pressure of supply was increased from 220 to 440 volts across the outers of the three-wire system.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure	£40,715	£46,300	£5,585
Number of units sold	213,395	261,247	47,852
Maximum load in KW.	197	224	27
Gross revenue	£3,645	£4,376	£731
Gross expenditure	£1,659	£2,726	£1,067
Gross profit	£1,986	£1,650	−£336
Average price per unit sold	3·95d.	3·85d.	−·10d.

The increases in load and in output are approximately in the same ratio to one another as in 1898, but each of these is only about half what was then recorded. Owing, however, to more use being made of motors, the load factor, which was 12½ per cent., is now 13½ per cent. Eight motors, aggregating 35 H.P., are let on hire, bringing the total up to 29 motors, of a total horse-power equal to 98; 33 arc lamps are used for public lighting, and 20 incandescents will be erected this year. Consumers have increased by 56 to 254; lamps connected by 3,826 to 18,559, and the additions to the mains laid amount to 1,344 yards making the total now on supply equivalent to 10 miles 460 yards. The revenue from all sources has fallen slightly, as is shown below:—

Revenue Statement.

	1899. Gross	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£3,507	3·95d.	£4,188	3·85d.	−·10d.
Meter rents	118	·13d.	150	·14d.	+·01d.
Hire of motors and work done	20	·02d.	38	·03d.	+·01d.
Sundry fees, &c.	—	—	—	—	—
Gross revenue	£3,645	4·10d.	£4,376	4·02d.	−·08d.

The high price of coal accounts for an additional expenditure of £175, the average rate per ton being 12s. 6d. against 9s. 6d. in 1898, but the quantity used per unit has been reduced by 8 per cent. The repairs include rebuilding a retaining wall and main flue, and special work in connection with repairs to deteriorated rubber cables, while the maintenance of the secondary battery has now to be met from revenue, the guarantee having expired. Each item in the costs has increased, except management, which is unaffected. As a result, works costs have risen by ½d. per unit to 1⅝d., and total cost by ⅝d. to 2½d., but even these figures are creditable to Mr. S. J. Watson, the borough electrical engineer, who after all has only a small works upon which to effect economies, and an output of just over one quarter of a million units.

Cost of Production.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal	£489	·55d.	£734	·67d.	+·12d.
Oil, waste, water and engine room stores.	98	·11d.	159	·15d.	+·04d.
Salaries and wages incurred in generation and distribution and attending public lamps	377	·42d.	505	·46d.	+·04d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and street lamps	88	·10d.	435	·40d.	+·30d.
Works costs	£1,052	1·18d.	£1,833	1·68d.	+·50d.
Rent, rates and taxes	179	·20d.	324	·30d.	+·10d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	353	·40d.	438	·40d.	·00d.
General establishment charges, stationery and printing, law charges and insurance.	74	·08d.	131	·12d.	+·04d.
Other expenses	1	—	—	—	—
Total cost	£1,659	1·86d.	£2,726	2·50d.	+·64d.

The increase in revenue during 1900 amounted to £731, and in costs to £1,067. The gross profit was therefore diminished by £336. Financial charges required an extra £505. Taking these sums together meant £841, which caused the net profit of £183 in 1899 to be turned into a net loss of £658 last year. The overdraft bearing high interest will be shortly repaid, and with the increase in output and lessened fuel bill, &c., the results should again turn the corner in the current year.

Profit Statement.

	1899.	1900.
Interest on loans and overdrafts	£995	£1,295
Sinking fund for repayments	808	1,013
Net profit carried to credit of general rate	183	−658
Gross profit	£1,986	£1,650

CITY NOTES.

Prospectus.

We publish among our advertisements this week the prospectus of Messrs. Ferranti, Limited, which invites applications for an issue of £100,000 5 per cent. mortgage debentures and £120,000 in £1 6 per cent. cumulative preference shares. This new capital has become necessary in order to enable the company to keep pace with the large amount of electrical manufacturing business which it is continually securing. Ever since the works were removed from London to Hollinwood a few years ago, extension has been the ruling principle. Messrs. Ferranti's work in central electric lighting stations is pretty familiar to all who have followed electrical developments, but it may not be so generally known that recently the company has paid special attention to the equipment of electric traction power stations, and several systems which are practically completed, have a good deal of Ferranti machinery. Now that electric traction occupies so large a place in electrical progress, this department promises to be well provided with business for years to come. A speciality has long been made of three-phase switch gear and switchboard work, and this also is an important feature of the business in presence of the polyphase tendency.

wanted for the South-Western Polytechnic, Chelsea, at £120 per annum.

during the past three years have been ·71d., ·15d. and ·19d. The prices charged are 4½d. and 2½d. per unit.

In addition to the public issue the capital includes £100,000 in ordinary shares; these the members of the vendor company take, paying for them in cash at par. The new company pays £284,000 for the assets. The average net profits for the past three years have been £19,180.

The works are not controlled on trade union lines, but the conditions of labour are proved, even to the satisfaction of local trade union officials, to be superior to those prevailing in some union shops. This is matter for considerable congratulation, after the hard struggles which the company has had with labour autocracy. We are pleased to note its progressive development, and wish this well-known firm greater success in the future.

City and South London Railway Company.

THE report of the directors for the half-year ending June 30th, 1901, to be submitted to the meeting to be held at 71, Finsbury Pavement, E.C., on Friday, July 26th, 1901, at 2 o'clock, reads as follows:—"The receipts from all sources for the past half-year have amounted to £53,653 19s. 2d., and the cost of working has been £28,096 8s. 4d., leaving a profit of £25,557 10s. 10d. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £26,906 13s. 7d. After making provision for the debenture stock interest, and the transfer to the renewal fund of £2,000, a balance remains available for dividend of £16,964 1s. 8d. Out of this sum your directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891 and 1896, and that a dividend at the rate of 1¾ per cent. per annum be paid upon the consolidated ordinary stock leaving a balance of £732 16s. 8d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

Half-year.	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets).
		£ s. d.
Ended December 31st, 1890 (11 days)	165,000	1,568 3 9
„ June 30th, 1891	2,412,843	19,403 6 9
„ December 31st, 1891	2,719,055	19,798 16 6
„ June 30th, 1892	2,813,162	20,931 4 2
„ December 31st, 1892	3,117,703	22,003 17 5
„ June 30th, 1893	3,146,556	22,458 6 9
„ December 31st, 1893	3,093,351	22,067 14 10
„ June 30th, 894	3,383,154	23,561 10 6
„ December 31st 1894	3,275,649	23,540 12 4
„ June 30th, 1895	3,1 3,199	23,711 5 8
„ December 31st, 1895	3,172,438	23,780 8 7
„ June 30th, 1896	3,192,672	24,021 13 0
„ December 31st, 1896	3,268,480	25,456 6 9
„ June 30th, 1897	3,437,810	26,403 3 6
„ December 31st, 1897	3,357,961	25,472 12 10
„ June 30th, 1898	3,478,977	26,3 6 16 4
„ December 31st, 1898	3,462,814	26,319 14 10
„ June 30th, 1899	3,540,098	26 749 3 0
„ December 31st, 1899	3,4 2,912	26,197 14 10
„ June 30th, 1900	4,169,717	33,608 2 3
„ December 31st, 1900	5,018,342	44,716 3 11
„ June 30th, 1901	5,88 ,726	51,013 17 3
Total since the opening of the line ..	72,779,608	£559,142 10 9

"Your directors report with much satisfaction that the traffic of the line has been steadily increasing during the whole of the half-year, and notwithstanding the high price of coal and other materials the percentage of working expenses has fallen considerably. The extension to Islington is rapidly approaching completion and will, it is anticipated, be open for traffic by the end of September next. The subway at London Bridge in connection with the Brighton Railway is nearly finished, and is waiting only for the completion of the lifts. In view of the opening of the Islington extension, 36 new coaches of an improved design have been ordered and, in order to cope with the increasing traffic, arrangements have been made to run an additional coach on each train during the busy hours of the day. The new engine and boilers at the generating station are now nearly ready. The engines and boilers that were provided at the opening of the railway, although still in good order, had been superseded by improved appliances, and it was thought better, both for economy and efficiency, to replace them by an entirely new plant, and the old engines and boilers have been sold. The original cost £10,704, having therefore to be credited to capital and replaced out of revenue, the amount has been debited to a renewal account which, on the other hand, has been credited with £2 670, the proceeds of the sale, with £1,000 transferred from the reserve fund and £2,000 charged against the revenue for the past half-year, leaving a balance of £5,034 to be liquidated out of the revenue of future half-years. The company's Bill, approved by the proprietors at the special meeting in February last, has received the Royal assent. The powers for the construction of the subway at the Angel station were withdrawn, in order to facilitate the passage of the Bill through Parliament. The Euston and Islington Bill referred to in the last report has, with a large number of other Bills for underground railways in London, been under the consideration of a Joint Committee of both Houses of Parliament, who have not yet issued their report. The arbitrator has given his award in the matter of St. Mary Woolnoth Church, in the form of a special case, which raises certain questions of law to be determined by the Court. The necessary steps are being taken to bring the matter to a conclusion. As it will be necessary to raise some additional capital to pay off various existing loans, and to provide the additional rolling stock required to meet the increasing traffic, the proprietors will be asked to sanction the issue of the capital authorised by the Act of this session in the form of preference stock, to be raised from time to time as required. No further progress has been made by the City and Brixton Company in the raising of the capital for the construction of the line, and the powers, if not renewed, will shortly expire. A Bill has been introduced into Parliament to extend the powers for another year, but it has not yet passed. The piece of this company's line between the old station at King William Street and the Borough remains therefore still unused. The dividend warrants will be posted on the 8th prox."

The British Thomson-Houston Company, Limited.

THE directors' report to be submitted to the sixth ordinary general meeting to be held at 83, Cannon Street, E.C., on Monday, July 22nd, at 2.15 p.m., reads as follows:—"The directors have pleasure in submitting their fifth annual report and statement of accounts.

"*Works at Rugby.*—The erection of the works is proceeding satisfactorily, and it is expected to complete same by the end of the year. The capital expenditure necessitated thereby was naturally not of earning capacity during the year.

"*Local Branches.*—Your directors have during the past year opened further branch offices in Newcastle, Manchester and Cardiff.

"*Hamilton, Motherwell and Wishaw Tramways.*—The Royal Assent to this Bill, which was promoted by the company, was given in July last. Negotiations are pending for acquiring lands, erecting the necessary buildings, and carrying out the permanent way and construction of the whole system.

"*Chatham and District Light Railways.*—An important contract has recently been entered into for the complete construction of the whole system; the various works and building are in active progress, and it is hoped to open the line before the end of the present fiscal year.

"*The Cork Electric Tramways and Lighting Company, Limited.*—Your directors are satisfied that your investment in this undertaking continues to be a sound and valuable asset.

"*Central London Railway*—The maintenance period for which this company is liable expires at the end of the present month; the plant supplied by the company has been running satisfactorily in every respect.

"*London United and Bristol Tramways.*—The company has successfully carried out the electrical and other works of these two lines, the former being the first in London electrically equipped and successfully running. The latter undertaking covers practically the whole of the city of Bristol, and is working most satisfactorily.

"*Power Distribution.*—The company has secured, and partly fulfilled, important contracts in connection with the power distribution scheme on Tyneside. This is the first important case of power distribution in this country, and the supply has recently been inaugurated.

"*Patents.*—It will be remembered that this company was successful in the action brought against it by Messrs. Chamberlain & Hookham for alleged infringement of certain meter patents. An appeal was, however, lodged, and is expected to be heard during the present month.

"The profits, after deducting general and technical expenses, discounts and interest, amount to £41,014 8s. 11d., of which sum £13,659 14s. 9d. has been applied, as shown in the profit and loss account.

"The available balance is £28,758 2s. 1d., which the directors recommend be distributed as follows:—

£18,000	0	0	to 7½ per cent. dividend on £240,000 ordinary shares fully paid.
7,550	0	0	to 7½ per cent dividend on £160,000 ordinary shares as called and paid from time to time.
2,050	14	6	to reserve, being 5 per cent. of £41,014 8s. 11d.
1,157	7	7	to profit and loss new account.
£28,758	2	1	

"The directors recommend that the dividend be paid on July 23rd next. One of your directors, Mr. W. B. H. Martindale, has recently resigned his seat on the board, and the vacancy created has been filled by General Eugene Griffin, a former director of the company. Messrs. C. Burrell, J. Hamspohn, W. A. McArthur, and J. T. Merz are the directors who retire by rotation, and are eligible for re-election. The auditors, Messrs. Price, Waterhouse & Co., retire, and are eligible for re-election."

Electric Construction Company, Limited.

MR. J. W. BARCLAY (deputy chairman) presided on Thursday last week over the eighth annual general meeting of the above company, held at Winchester House, E.C., and in moving the adoption of the report, said the result of the business of the year was a net profit of £20,149 6s. 5d., whereof they proposed to divide £17,165, being less than the amount earned by £3,284 6s. 5d. The profits, however, which they had to deal with amounted to £30,018 18s. 2d., made up of the profit on the business of the year he had just mentioned, £4,777 1s. 9d. brought from last year, and £4 792 10s. the premium on the issue of 6,390 preference shares. These profits, amounting to £30,018 18s. 2d., they recommended should be appropriated in the payment of 7 per cent. dividend on the preference shares and 6 per cent. on the ordinary shares, requiring together £17,165; and, further, that the premium of £4,792 10s. on the preference shares and £5,207 10s. out of surplus profits (together £10,000) be added to the general reserve fund, which will then amount to £30,000. The interest on loans and debentures showed an increase of £3,200, but on the other side of the account there

13½ per cent. Eight motors, aggregating 35 H.P., are let on hire, bringing the total up to 29 motors, of a total horse-power equal to

important feature of the business in presence of the polyphase tendency.

was a new credit for profit on the Madras electric tramways of £3,023 19s. 2d. In former years, when the amount standing against the tramway company was a debt, the interest on it was deducted from the interest paid, so that the increased interest charge was substantially met by the tramway profits. The general charges showed a reduction which was more apparent than real, because part of the general charges, which formerly appeared on the debit side of the account, had been charged to the work in respect of which the expenditure was made, the object being to ascertain as closely as practicable the prime cost of their manufactures. The higher price of coal diminished the profits by some £750, but this year a benefit of £500 from the lower prices now current was expected. They would observe no doubt with approval the very substantial amount, £5,000, which had been placed to the depreciation account. This fund now amounted to £38,000, and had all been appropriated from profits during the past eight years. There was an increase of £800 in the maintenance of the works—£2,943 8s. 6d. having been expended to keep the buildings and plant in first-rate order. Turning to the balance-sheet, the expenditure on the new workshop and plant during the year amounted to £15,763 10s 2d. This was in addition to £26,250 which appeared in the accounts for 1900, making the expenditure upon the new shops upwards of £42,000—an increase of £2,000 on the original estimate. He was happy to think that their important capital expenditure was drawing to a close. With these outlays they might feel assured that the company was provided with workshops and tools of the most improved description, to enable them to meet the severe competition which they were told was coming. The item "sundry debtors" had increased by £40,850. This was largely due to the company's increased business. Practically no part of this large amount of £106,000 was in the nature of a bad or doubtful debt. It was largely made up of balances retained under contracts for installations until 12 months after the plant was running. The "work in progress" showed an increase of over £15,000, which also arose from the large amount of work passing through the factories. These three items accounted for the increases in capital and liabilities of the company which appeared on the other side of the account. They would be pleased to observe that their equipment of the City and South London Railway had proved satisfactory to the public as well as to the railway company. They had heard of no complaints from any quarter, and the best proof of the company's satisfaction was that they had obtained a new contract for further extensions. It must also be very satisfactory that the relations between the board and all classes of the company's employés were thoroughly harmonious. They believed that all took a deep interest in the prosperity of the company, and the board endeavoured to stimulate that interest by a bonus, depending on the net results of the year's business, and also by considering in the administration of the works the comfort and welfare of the employés as fully as possible. With regard to the prospects of the business, they would, no doubt, have observed that some newspapers continually reiterate assertions that electrical manufacturers in this country were behind the time. The only ground they had to offer in support of this assertion was that the use of electricity for traction and motive purposes was much behind what it was in America. But if this was the case, as no doubt it was, the fault did not lie with the manufacturers, as they would understand when he again reminded them that this company equipped at Liverpool the first overhead electric railway in the world, and also, 10 years ago, the South Staffordshire electric tramways, both with complete success. The delay in the use of electricity was due to the vexatious restrictions imposed by Parliament through the Board of Trade, and to the reluctance of corporations to allow private enterprise to develop the tramways and lighting of their towns. The newspapers ought, therefore, to put the saddle upon the right horse, for, so far as he knew, the manufacturers of electrical machinery in this country had proved themselves equal to produce any description of plant that might be required. In view of these facts, he did not think they should give much weight to these jeremiads on the decline of British enterprise. No capable workmen were idle who were willing to work, and if their exports did not increase at the rate they did some years ago, the true explanation, he believed, was that the masses of their population had so increased in well-being that they consumed a much larger portion of their manufactures than was the case 20 or 30 years ago.

Sir JAMES PENDER, Bt., seconded the motion.

Replying to questions, the CHAIRMAN said the company had a large holding in the Electric Power Storage Company, which they were reducing from time to time, and it was not part of their business. They would be glad to tender for the London tramways, but he was afraid they could not accept the conditions of the London County Council. The L.C.C. wished to come into their workshops and make prescriptions with respect to their workmen, which they believed would tend to demoralise their establishment. They tendered for the Metropolitan Railway Company, but there again, financial conditions were mixed up with the contract, and they were not prepared to do financial business with their manufacturing business.

The motion was passed, and subsequently a number of amendments to the articles of association were agreed upon to bring them into harmony with the Act of 1900.

Edmundson's Electricity Corporation, Limited.

THE fourth ordinary general meeting of the above company was held at the offices, Broad Sanctuary, Westminster, on Thursday, Mr. J. R. Wigham (chairman) presiding.

In moving the adoption of the report, the CHAIRMAN said:—"Our profits for the year, after paying interest on the debenture stock and after providing for dividend upon the preference shares, amount with the balance brought forward from last year to £24,980, say in round figures, £25,000. Acting upon the suggestion made by shareholders at the last general meeting that the directors should pay an interim dividend on the ordinary shares for the half-year ending September 30th last, they had done so, and the amount paid was £4,215 13s., being at the rate of 5 per cent. per annum. They now recommend that a dividend at the rate of 2 per cent. per annum be paid on the ordinary shares for the half-year ending March 31st, making a dividend of 7 per cent. for the year. They also recommend that a similar 7 per cent. dividend for the year be paid upon the deferred shares, and that, in addition, a further £5,000 be written off the goodwill account, and that the amount of £4,000 be placed to a reserve account, leaving a balance of £2,201 to be carried forward to next year's statement of accounts. The steady growth in our profits, I think, amply justifies the directors in recommending this increase in the dividends. A much larger proportion of the capital invested in our various undertakings is now producing a return, as will be seen by comparing the amount received this year on account of interest and dividends, £11,108, with the amount received last year, £4,438. A considerable portion of our investments have, of course, not yet reached the productive stage, so that still better results may be expected from year to year in that respect. Turning to the balance-sheet, you will see that a further amount of debenture stock has been issued, making a total of £120,000, and that the £100,000 of 6 per cent. preference shares, authorised last year, had also been issued. On the other side the principal item to attract attention is "Investments in subsidiary companies," amounting to £331,394. This amount has largely increased since our last balance-sheet, owing to the completion of many of the works which were then only in course of construction, and also owing to the very considerable extensions which have been necessary in several of our older works. The shares which are held in these various companies have all been taken at cost price in the balance-sheet, and a large number of shares, which represent the profit made in carrying out our contracts, have not been taken into account at all. If our investments were taken at par value instead of at cost, the amount would be increased by something like £60,000. When these shares are realised from time to time they will be available for paying increased dividends. As an example, I may take our interest in the Woolwich Company, in which we hold about £35,000 out of the total capital of about £50,000. The undertaking had grown into a very considerable concern, and the Corporation of Woolwich, whose borough has now been largely extended, are anxious to take the lighting of the whole borough into their hands, and they have made an offer of £80,000 for the undertaking, which has been accepted, and the necessary agreements are being prepared, and will in all probability be completed next week. We have over £5,000 of these Woolwich shares which have not been taken into account in the balance-sheet, and which will be worth about £11,000, and we have about £9,000 of similar shares, which have been taken at par, and which now will be worth about £20,000. I give this as an instance of the way in which our investments in these local companies increase in value, and also as an instance of the conservative manner in which the directors have dealt with the valuation of their investments. During the past year the various stations under our control have made very satisfactory progress, both in regard to the number of consumers added, and in their increased earning power. New stations which were in progress last year have been completed and opened, and are working satisfactorily, at Melton Mowbray, Lymington, Montrose, Brechin, and at Sandown and Shanklin, in the Isle of Wight. Until recently a separate local company has been formed for each of the towns which we deal with, but during the last session of Parliament we obtained powers for electric lighting in a number of towns, and for building electric tramways in two or three of them, and all these powers were taken in the name of a single company, the Urban Electric Supply Company, which company has recently issued its capital, our company retaining an interest of rather over one-third. The contracts for the erection of the different works for the Urban Company, and the management of them when erected, will be in our hands for a number of years, and we look to this, the largest of our subsidiary companies, to provide us with an additional source, from which satisfactory profits for our company will be realised."

Mr. W. R. DAVIES seconded the motion, and it was carried without discussion.

Telegraph Construction and Maintenance Company.

SIR ROBERT HERBERT presided at the half-yearly meeting of this company, held at the offices in Old Broad Street, on Tuesday. He said that they were in a position to pay the interest at the rate of 10 per cent. per annum for the half-year. After referring in very appreciative terms of the services of the late Sir Anthony Hoskins to the company, and the great loss the board had sustained in the death of so distinguished a naval officer, the CHAIRMAN said that it would be a matter of gravest consideration where to look for a man to take his place. In regard to the general affairs of the company, they were carrying on a great deal of work; the factories were working harder than ever, and with the improved machinery were turning out the work better than ever. The *Anglia* and other ships were doing their work in full response to the work done by the factories, and they had laid a great many miles of cable very successfully since the last meeting. At the last meeting they informed the shareholders that they were constructing a new ship which they hoped would rival the *Anglia* in its capacity for carrying out their service. That work had now made a fair start, and they felt no doubt that in due time—long before the necessity for laying the Pacific cable arose next year—

ing loans, and to provide the additional rolling stock required to meet the increasing traffic, the proprietors will be asked to sanction

amount to £30,000. The interest on loans and debentures showed an increase of £3,200, but on the other side of the account there

that ship would be afloat and in a very efficient condition. He referred to the answer given in the House of Commons to Sir E. Sassoon by Mr. Austen Chamberlain, stating what had been done with reference to the preparations for the Pacific cable. The Pacific Cable Board was actively engaged in making all the arrangements. 1,500 miles of the route had been surveyed, and the *Britannia* was now engaged between Norfolk Island and Fiji. Some of the cable houses had been placed. They would not produce the cable until towards the end of next year. They would thus be able to do it without interfering with the other and more pressing work which they now had in hand. They would have the cable thoroughly constructed in due time.

A vote of thanks to the board and staff closed the meeting.

Electrical Power Storage Company, Limited.

The twelfth half-yearly general meeting of the proprietors of this company was held on Thursday of last week, Mr. J. Irving Courtenay (chairman) presiding.

In moving the adoption of the report, the Chairman said that after payment of debenture interest, and adding £1,000 to the contingent fund, there was a balance of £4,665, which added to the amount brought forward from last year gave a total of £4,923 available for distribution, but of that sum the directors recommended a similar dividend to that which had been paid since 1892, viz., 5 per cent., carrying forward £432. During the year the area of the Millwall works had been materially enlarged, and a fireproof building, three stories in height, had been erected for use as stores at a cost of £1,300. New labour-saving machinery and plant had been provided for the works at a cost of £1,537; the buildings, plant and tools had been maintained at a cost of £1,910, and a sum of £788 had been written off for depreciation. It would thus be seen that everything was being done to keep the works in a first-rate condition and to secure a most up-to-date plant. They were still adding to their contingent fund, which, as they would remember, was commenced to provide for any exceptional outlay which might occur on account of the company's numerous maintenance contracts. Although those maintenance contracts had been running since 1891 they had so far never had occasion to make use of the fund, and that was undoubtedly due to the fact that they steadfastly refused to obtain immediate business by quoting such low maintenance rates as must inevitably entail serious loss in the course of a few years. He was glad to state that a gold medal had been awarded their exhibit at the Paris Exhibition, this being the highest class of award given to any accumulator manufacturer. The company also had an exhibit at the Light Railways Exhibition which was held at the Agricultural Hall last year. The Exhibition was confined entirely to industries connected with electric traction, and created a large amount of attention among corporations and other public bodies interested in that class of traction. At the Glasgow Exhibition the company were showing the only electrically-propelled automobile exhibited. That had been done with a view of removing from people's minds the prejudice which had hitherto always associated ugly and cumbersome vehicles with any connected with electric traction. They were exhibiting a "Victoria," which, complete with a battery capable of running it 35 to 40 miles, weighed only 23 cwt., and the accumulators were so neatly hidden away, that the question was invariably asked "where are the batteries?" The comments and notices which they had so far obtained had been most appreciative; indeed, he might say enthusiastic, and they had already received a large number of inquiries for similar and kindred vehicles. Considerable attention was still being devoted to perfecting both the company's "Faure-King" and other like forms of traction battery, and so far as this country was concerned, they could certainly say that they manufactured practically the whole of the batteries which were supplied in connection with electrically-propelled vehicles. They intended, moreover, to keep well in front when the inevitable increase in the demand for automobile batteries came, as it must do shortly, and they had therefore, during the year given much time and thought to motor car experiments, not only as regards batteries, but also in connection with car bodies, frames, springs, chains, tires, and systems of controlling. By means of their own electric brougham they had been able to collect a quantity of reliable statistics and information. He might mention that a company which had recently been established in London, and which had been successful enough to supply cars to Her Majesty the Queen and other notable personages, was now using E.P.S. cells, the company having been able to give them a battery occupying the same space, and of the same weight, but having an output 60 per cent. above that given by the battery of foreign manufacture which came over with the original vehicles. New accumulators were continually being invented, and new companies formed with the object of exploiting them, but he was pleased to tell them that in spite of the increased competition the amount of business transacted during the past year had been greater than that of any previous year of the company's existence. Amongst the larger contracts completed during the year he might mention extensions for the Corporations or Urban District Councils of the following places:—Wigan, Walsall, Bristol, Whitehaven, Doncaster, Bradford, Rotherham, Perth, Motherwell and Ilford, and they commenced the new financial year with work in hand for similar contracts sufficient to keep the factory busy for some considerable time to come. He thought they might therefore congratulate themselves on the position of the company and its prospects for the future, although the keen competition to which he had referred left only a small margin of profit. Indeed, they were constantly hearing complaints about the very low prices which were at present ruling for accumulators, and that condition of the industry demanded continual effort towards economy in production and the equipping of their works with the latest machinery and appliances.

Sir James Pender seconded the motion.

The Chairman, replying to a shareholder, said that with respect to the new accumulator invented by Mr. Edison, after carefully studying the matter, they were of opinion that the ascertained results would not cause any immediate revolution in secondary battery practice.

The report was adopted.

The re-election of the retiring directors and auditors having been carried, a vote of thanks passed to the board, terminated the proceedings.

Lymington Electric Light and Power Company.

The first annual meeting was held at the works in Bath Road recently. Mr. Keppel Pulteney presided. The report stated a supply of current was first given from the company's works in December, since which time the supply had been maintained uniform and without interruption. The number of lamps connected to the mains at the end of the year were equivalent to 1,705 8-c.p. lamps. This number had been increased to 3,251 by the end of April, and there were now 106 consumers connected to the mains. This, states the report "must be considered a most successful start in a town the size of Lymington." The balance-sheet (to December 31st, 1900) shows an expenditure of £11,259 13s. 6d. on capital account. The revenue account shows an expenditure of £157 4s. 10d. and a receipt of £177 8s. 3d., of which £140 represents the amount paid for the public lighting. The report was adopted, and as the profit on the year's trading does not amount to a sufficient sum to pay a dividend of 4 per cent., Messrs. Edmundson's Electricity Corporation will, under their contract, provide a further sum to allow of this dividend being distributed.

Eastern Telegraph Company, Limited.

Sir John Wolfe Barry, K.C.B. (chairman), presided on Wednesday, at Winchester House, Old Broad Street, over the fifty-eighth half-yearly ordinary general meeting of the above company, and, in moving the adoption of the report, said he hoped the shareholders would consider the report a satisfactory one, as the directors themselves did. They recommended a final dividend of 1¼ per cent. and a bonus of 2 per cent., which, together with previous dividends paid, made 7 per cent. for the year. They were able also to place a very substantial sum to reserve. The gross revenue for the half-year had been £624,000, as against £534,000 in the corresponding period of last year—a substantial increase of £80,000. He was bound to say, however, that the increase was more apparent than real, for the increase in the coffers of the company was to some extent at the expense of the South African Company. Under the new adjustment they took more from the joint purse than the South African Company, whose shares they held. They had received extra revenue from South Africa since the war began; but, on the other hand, they hoped to see signs of a revived commercial activity in South Africa, which would be much more pronounced when the war was brought to a conclusion. They would prefer to see an increased revenue from commercial activity rather than from the effect of warlike operations. The same remarks applied to China, where there had been exceptional disturbances. All the other sources of traffic were fluctuating. Upon the whole, he thought they might consider the result satisfactory. The ordinary expenses of the half-year were £135,000, compared with £128,000, and the increase was due to the increased volume of business transacted. The percentage of working expenses bore no signs of increase. There was an increase in the staff pension fund of £1,500, owing to the remodelling of the scheme for allowing the staff to retire at 55 instead of 60. To keep the cables in a satisfactory condition they had employed rather more cable than in the previous year, and had put into the system 244 knots, as against 107 knots in the corresponding period of 1899. They had placed £205,000 to reserve, which was the largest sum ever placed to reserve in one half-year. They must do that to keep the company in a stable conditions, for they were committed to large extensions in various directions, and although they put £205,000 to reserve, they were taking £400,000 from it on account of the new cables forming the new route to the Cape. They were engaged in the renewal of the original Red Sea cable. Their policy was from time to time to draw on the reserve fund for extensions, with a view to improving their position as carriers of the messages of so large a portion of the population of the world. The cable between the Island of Ascension and Sierra Leone was opened in April last, and in May the Durban-Mauritius section of the Cape-Australian Cable was laid. They knew that the Eastern Extension Company were forward in completing their link, and they had every hope that before the end of the year there would be communication between Mauritius and Western Australia, and that the whole system contemplated would be completed about next spring. Referring to the Inter-Departmental Committee which was inquiring into the whole question of cable companies, the chairman said that the company, through its managing director, had given every assistance, and they awaited the report with confidence. There had been much criticism with respect to the rates for the Indian traffic, which were felt to be too high compared with the rates to lands more distant. The company would welcome a reduction, but they had been unable to make them in consequence of existing relations with other parties. They had every hope, however, that the difficulties would shortly be removed, and that they

In moving the adoption of the report, the CHAIRMAN said:—"Our profits for the year, after paying interest on the debenture stock and after providing for dividend upon the preference shares, in its capacity for carrying out their service. That work had now made a fair start, and they felt no doubt that in due time—long before the necessity for laying the Pacific cable arose next year—

would be able to make a substantial reduction in the rates. In conclusion, the Chairman referred at some length to the question of the coding of messages, and showed that 95 per cent. of the messages carried by the company were coded. The result of expensive codes was that merchants sent messages which, when transcribed, only cost about 1d. a word. This was felt by many to be a hardship on individuals who wished to send private messages and could not afford to do so, and the company were in communication with the Indian Government and the Post Office with the view of having a code kept at every Post Office, so that a person might use it. The Post Office saw difficulties in the way, but he hoped they would be removed.

Mr. J. DENISON PENDER seconded the motion, and it was carried.

Direct United States Cable Company, Limited.—The board has been resolved to recommend a final dividend of 3s. per share and a bonus of 1s. per share (both free of income-tax), such dividend and bonus to be payable on and after the 31st inst., making with the three interim dividends already paid a total distribution of 3¾ per cent. for the year ended June 30th last, and, after placing £10,000 to the reserve fund account, carrying forward a balance of about £3,532. The transfer books of this company will be closed from July 16th to the 30th.

National Telephone Company.—The directors for the half-year ended December 31st last, recommend a dividend at the rate of 5 per cent. per annum on the ordinary shares, transferring £85,000 to the reserve fund and carrying £5,698 forward.

Dublin United Tramways Company.—The directors recommend a dividend at the rate of 4 per cent. per annum for the half-year ended 30th ult., carrying forward £3,374. The sum of £6,337 has been charged against revenue during the half-year for compensation for accidents and legal expenses connected therewith.

Harrow Electric Light and Power Company.—The annual meeting was held last week at the offices at Harrow, and the report of the directors was carried unanimously, and other incidental business was transacted.

St. James's and Pall Mall Electric Light Company.—The directors have declared an interim dividend for the half-year ending June 30th at the rate of 10 per cent. per annum on the ordinary shares. The amount of electricity sold for the quarter ending Midsummer is returned at 1,115,593 units, estimated to produce £19,523, as against 1,035,927 units, which produced £18,172, for the corresponding period of last year.

Central London Railway.—The 12th ordinary meeting will be held at the Holborn Restaurant, the King's Hall entrance, W.C., on 8th prox., at 1 p.m. The transfer books will be closed from 25th inst. to 8th prox., inclusive.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to—British Insulated Wire Company, Limited—£250,000 4½ per cent. 1st mortgage debenture stock.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending July 12th were £574; corresponding week last year, £520; increase, £54. Total to date, £13,162, corresponding period last year, £12,006; increase, £1,156. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for six days ending July 13th were £1,043; corresponding week last year, £949: increase, £93. Total to date £1,827; corresponding period last year, £1,750; increase, £77.

Bristol Tramways and Carriage Company.—The receipts for the week ending July 12th were £5,066; corresponding period last year, £3,604; increase, £1,462.

Central London Railway.—The receipts for the week ending July 13th were £6,145; previous week, £6,079; increase, £66. Total receipts to date (two weeks), £12,224. Miles open, 6.

City and South London Railway.—The receipts for the week ending July 14th were £1,872; corresponding week last year, £1,436; increase, £436. Total to date, £3,744; corresponding period last year, £2,893; increase, £961. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending July 13th were £274 10s. 10d.; corresponding week last year, £272 12s. 4½d.; increase, £1 18s. 7½d. Total to date, £5,382 17s. 1d.; corresponding period last year, £5,009 17s. 9d.; increase, £372 19s. 4d. Miles of track open, 3. Car miles run, 1901, 5,222; 1900, 5,153. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending July 12 h were as follows:—D.U.T. Co., electric cars, £4,172 13s. 9d.; D.S.D. Co., electric cars, £1, 05 1s. 9d.; total, £5,377 15s. 6d.; corresponding period last year—D.U.T. Co., electric cars, £3,819 16s. 2d.; ditto, horse cars, £3 14s. 4d.; D.S.D. Co., electric cars, £1,144 14s. 4d.; total, £5,080 4s. 10d.; increase, £347 10s. 8d.; aggregate to date, £8,8:0 18s. 7d.; aggregate to date last year, £8,459 1s. 7d.; increase, £481 17s. 1d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and two miles by horses, for the corresponding period last year.

Liverpool Corporation Tramways.—Traffic returns for the last fortnight were £18 569 7s. 2d., an increase of £3,379 9s. 0d. over the corresponding period last year. The mileage run was 428,978, against 77,?97. The number of passengers carried was 4,234,525, against 3,188,266 last year, an increase of 1,044,259.

Liverpool Overhead Railway.—The receipts for the week ending July 14th were £1,766; corresponding week last year, £1,755; increase, £10. Total from July 1st to date, £3,497; corresponding period last year, £3,442. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

THE flatness throughout the whole of the Stock Exchange, upon which we commented last week, became even more accentuated in the early part of this. Violent American selling of the premier British security forced the price of Consols to a level which it has not reached since 1870. Added to the sales from the United States there came more stock from the Continent. Germany sold in order to provide money for her sorely-pressing financial needs; France in order to raise the necessary funds for meeting losses incurred through unwholesome speculation, largely in electrical traction enterprise. A wave of suspicion and distrust has swept the Stock Exchange from end to end, and the worst of its effects made itself felt upon the investment markets.

The season of railway dividends is upon us. First to make its declaration was the City and South London, as we chronicled last week. It was a quite unexpectedly good one, and for a moment the home railway market asked if it were possible that others might be like it. But the Brighton and Great Eastern Companies' announcements changed the hopeful horizon, and down came all the railway stocks like a house of cards. Central London Ordinary dropped 3, the Deferred 1 per cent., but the other electric stocks are unchanged, although no large sales could be made at current quotations. Almost the only railway stock to show any firmness at all is Metropolitan Consolidated. The company, according to Stock Exchange ideas, stands a better chance of success after electrification than does the District. The Ordinary stock of the latter has fallen to 29.

In the Supply department, a comfortable rise of ⅜, leaves Edmundson's Ordinary at 5¾ *ex* dividend. Buyers came along after the meeting the other day, when the satisfactory report was supplemented by hopeful auguries for the future. Beyond this, the changes in this market are generally downward. Notting Hills relapsed 10s., regaining the price at which they stood a fortnight since. The selling of St. James's and Westminsters has ceased after the successful flotation of the Central Electric Company's Debenture, upon which a small premium of 1 per cent. is now quoted. The St. James's dividend is about what was expected. Chelsea Debenture is two points lower, and the Ordinary shares are also a dull market. Charing Cross 4 per cent. Debenture stands at 103, and the Kensington-Knightsbridge-Notting-Hill stock of the same description is a point higher. Brush issues are losing some of their recent firmness; there is ⅛ loss shown on both Ordinary and Preference. Metropolitan Ordinary and Preference are 10s. down: "a healthy reaction" the market calls the decline.

National Telephone shares are quiet, but there is some demand for the company's senior issues, and the 3½ per cent. Debenture stock is rather harder. Mr. Austen Chamberlain's reply to Mr. Bartley on Monday night, saying that the Post Office telephone service will probably be ready for commencement in October, has not affected the shares, and when matters financial begin to settle down a little, the wise man will perhaps buy a few "Telephones" at about their present low price. They now carry a 5 per cent. dividend just declared. United River Plate are better at 5¼ *ex* dividend, the yield proving attractive to a few speculative investors.

As regards the Telegraph market, the firmness of Eastern Ordinary calls for first notice. This is the quarter for the large dividend, and cheques were sent out to-day, Wednesday, for the last distribution of 3¼ per cent., making 7 per cent. for the whole year that ended on March 31st last. At its present price the return on the stock to an investor is just about 5 per cent.,—good interest even in days like these, when India 3 per cent. stock is officially offered at 98 without sufficient applicants being found to subscribe for more than one out of the three millions provided. Eastern Extension shares retain their last week's advance, but the Debenture stock is somewhat dull, and with the present plethora of gilt-edged investments paying good yields, the price of this security may relapse another two or three points. Globe Telegraph and Trust are unchanged on the 4s. 6d. dividend, the same amount as was declared at this time in 1900. West African Telegraph Debentures have advanced to par, upon inquiries induced by the company's report. As the total available balance for distribution amounted to £52,007 for the year, and the debenture interest only requires £7,919, the bonds appear to be well secured as regards their dividend. Amazon Telegraph shares are quoted at 4, and the Debentures at 80 have come to a pause in their upward career. The Anglo-American group shows no alteration; the final dividend and bonus of 4s. failed to influence Direct United States Cable shares, and the slump in Yankee rails has produced no appreciable effect upon the Anglo-American Telegraph Company's issues.

Telegraph constructions regained the amount of dividend deducted without any effort, the quotation remaining unaltered. The Debenture stock of the London United Tramways Company is firm at 105½, but Imperial tramway shares are motionless.

constantly hearing complaints about the very low prices which were

relations with other parties. They had every hope, however, that the difficulties would shortly be removed, and that they

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation July 10th.	Closing Quotations July 17th.	Business done during week ended July 17th, 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs	100	...	...	...	98 —101 xd	98 —101 xd	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3¼%	53 — 56	53 — 56	53	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	98 —100	98 —100	99⅝	9c½
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	9¾ — 10¼	9¾ — 10¼	9¾	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3⅞ — 4¼	3⅞ — 4¼	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185 xd	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102 xd	101⅜	101⅛
16,000	Cuba Telegraph	10	8 %	7 %	...	7 — 8	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	14½ — 15½	14½ — 15½	14 11/16	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99 -103⅞ xd	99 —103⅞xd	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3½ %	10½ — 11½	10½ — 11½	...	...
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102 xd	99 —102 xd	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	141 —146	143 —148	146½	143½
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	89 — 92	89 — 92	90⅜	89
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	109 —113	109 —113	109⅜	109½
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13⅜ — 14¼	13⅜ — 14¼	14⅛	13⅞
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	110 —115	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5½%	...	100 —103	100 —103	100½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5¼%	9⅜ — 10¼	9⅜ — 10¼	10¼	9 15/16
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14⅜ — 15½	14⅜ — 15½	15⅛	14 13/16
150,000	Great Northern Telegraph, of Copenhagen	10	12½ %	...	15 %	30 — 32	30 — 32	...	...
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 -102 xd	99 —102 xd	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	43 — 47	43 — 47	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ⅜	¼— ⅜	...	...
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3⅜ — 3⅝	3⅜ — 3⅝	3½	3 7/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 12	11 — 12	11⅞	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 12	11 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	4 3/16	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	89 — 92	90 — 93	92	90
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	95 — 98 xd	95 — 98	95	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	¾— 1	¾ — 1	1	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102 xd	99 —102 xd	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	7⅞	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5⅛	5 — 5⅛	5¼	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4¾— 5⅛ xd	4¾— 5⅛xd	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104 xd	101 —104	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜ -14¼ xd	13⅜— 14¼	14⅛	13⅞
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104 xd	101 —104 xd	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103 xd	100 —103 xd	...	...
88,321	West India and Panama Telegraph	10	2 %	1%	...	⅜ — ⅝	⅜ — ⅝	⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	5⅛	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	3⅜	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104 xd	101 —104 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞ — 8¼	7⅞ — 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½ — 9	8½ — 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	9 5/16	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼ — 5⅝	5¼ — 5⅝	5 5/16	5¼
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5⅝ — 6¼	5½ — 6	5⅝	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —114	107 —110 xd	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8 — 9	8 — 9	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½ — 13½	12½ — 13½	12⅝	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	120 —125 xd	120 —125 xd	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	4 %	4 %	8½ — 9½	8½ — 9½	8⅝	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Red. ...	...	...	...	...	103 —106 xd	103 —106 xd	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5¼— 5⅝	5¼— 6 xd	6	5⅞
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6 xd	5⅝	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	104 —107	102 —105 xd	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11½— 12½	11½— 12½	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	103 —105	102 — 105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1¼— 1⅝	1¼— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13¾— 14½	13 — 14	13⅞	13½
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	...	...	...	108 —111 xd	108 —111 xd	...	...
250,000£	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	94 — 97 xd	94 — 97 xd	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½ — 16½	15 — 16 xd	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	8¾	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100 xd	97 —100 xd	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	11½ — 12½	11½ — 12½	12	11½

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Liverpool Overhead Railway.—The receipts for the week ending July 14th were £1,766; corresponding week last year, £1,755; increase, £10. Total from July 1st to date, £3,497; corresponding period last year, £3,442. Miles open, 6 miles 67 chains.

The Debenture stock of the London United Tramways Company is firm at 105½, but Imperial tramway shares are motionless.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation July 10th.	Closing Quotation July 17th.	Business done week ended July 17th, 1901. Highest	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	14½ — 15½	14 — 15	15½	14⅝
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅝	12½
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	122 —125	122 —125	124½	123⅝
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11	10 — 11	10⅝	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	6⅛ — 6⅝	6 — 6½	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞	1 11/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —104	99 —102 xd	94½	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14 —15	14 — 15	14⅝	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	107 —111 xd	109 —113	...	...
206,297	Central London Railway, Ord. Stock	Stock	...	...	...	93 — 96	90 — 93	92	...
78,703	Do. do. Pref. half-shares	5	...	...	...	98 —101	98 — 101	...	...
78,703	Do. do. Def. do.	5	...	...	...	93 — 96	92 — 95	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1½%	54 — 56	54 — 56	54	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5½ — 5⅝	5½ — 5⅝	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3½ — 4	3½ — 4	3 5/16	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	102 —107	100 —105 xd	103	102½
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1 — 1⅛	1 — 1⅛	1⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	87 — 89	80 — 85 xd	81	80½
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	94 — 98	92 — 96	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6%	1⅞ — 2⅛	1⅞ — 2⅛xd	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2⅛ — 3	2⅛ — 3 xd	2	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	100 —103	98 —102 xd	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½ — 16⅛	15½ — 16⅛	16	...
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21 1/16	21⅜
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3½%	8½ — 8¼	8½ — 8¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	13 — 13½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	36 — 40	36 — 40	39½	38½
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	101 —104 xd	101 —104 xd	104	103
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10 — 11	10½ — 11½	11	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—¼
National Electric Free Wiring, 12/6 paid, ½—⅝.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16½.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (June 6th, 1901).

MARKET QUOTATIONS, Wednesday, July 17th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	82/-	82/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	80/-	80/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£15	£15	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23	£23	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¼d.	8¼d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	61/-	61/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£294	£294	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¾d.	8¾d.	..
c ,, Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c ,, ,, (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g ,, Rod	per ton	£85	£85	..
g ,, (Electrolytic) Bars ..	per ton	£82	£82	..
g ,, ,, Sheets ..	per ton	£90	£90	..
g ,, ,, Rod ..	per ton	£84	£84	..
g ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	6/-	6/-	..
h India-rubber, Para fine	per lb.	3/8 to 3/9	3/8 to 3/9	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	44/8	43/8	1/- inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£12 7 6 to £12 10	£12 10 to £12 12 6	dec.
g ,, ,, Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/8	From 1/8	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£129 to £131	£130 to £131	dec.
g ,, foil	per lb.	1/6	1/6	..
n ,, wire, Nos. 1 to 16 ..	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8¼d.	8¼d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 8 ply 10 lbs.	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 5	£14 5	..
k Zinc, Sh't. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

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79,900	Westminster Electric Supply, Ord., 101 to 80,000...	...	5	12 %	13 %	10½%	11½ — 12½	11½ — 12½	12	11½

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

CANADA AND STATE-OWNED CABLES.

We reprint a circular letter addressed to various bodies representing trade and commerce throughout the Empire, and in which the Ottawa Board of Trade urges the advisability of State-ownership of submarine telegraph cables.

Ottawa, 20*th June*, 1901.

On behalf of the Ottawa Board of Trade, the President and Council have the honour to submit the following remarks, together with the appendices hereto, on the movement to secure the cheapest, the speediest, the freest, and the most effective means of intercourse between all the King's subjects throughout his vast empire.

Representing trade and commerce in the capital of Canada, the Ottawa Board of Trade feels it a public duty incumbent on them to take this means of expressing the conviction they have reached that all the British possessions throughout the world should be directly connected by State-owned telegraph cables under the control of the Post Office.

Such a scheme is regarded by members of the board as an effective means of fostering trade and stimulating commercial activity, at the same time constituting a bond of Imperial unity of inestimable value.

The proposal requires not only that the connecting transmarine cables should be under Government control, but likewise that the land telegraphs of the several British possessions should be State-owned. The land telegraphs of the United Kingdom, New Zealand, the Australian States, India and South Africa, are already nationalised and administered by the Post Office. Canada is the only exception; but the transfer of the Canadian telegraph lines to the Post Office, together with the laying of a State-owned cable across the Atlantic, is, we are informed, under the consideration of the Government, and it may be assumed that Canada will not long remain the only country within the Empire where the telegraph system is not, in the public interest, controlled by the State.

More than a year ago the scheme of world-encircling telegraphs was earnestly considered by this board, and resolutions were then passed pointing out the necessity for establishing the Pacific cable as the initial link in such a system of State-owned cables.

It is a matter of great gratification to the board to know that the Pacific cable is now being established, under a joint agreement between the Home Government and the Governments of Canada, New South Wales, Victoria, Queensland and New Zealand, and that there is every prospect of Canada being connected with the United Kingdom at an early date by a State-owned trans-Atlantic cable. With these works completed, and the Canadian land lines nationalised, the whole distance from England to the shores of the Indian Ocean, say at Perth, the capital of Western Australia, will be covered by a series of cables and land telegraphs under State control. Perth is near the 116th meridian east, while it is 24° of longitude westerly from London. Reckoning by meridians of longitude, therefore, two-thirds of the globe will be girdled by a State-owned telegraph service, so soon as the Pacific cable and Canadian lines associated therewith are established as national works.

The necessity for connecting India and other British possessions in Asia with the Imperial system of telegraphy must, however, be recognised. On reference to the papers appended it will be found that the Imperial scheme of cables to traverse the Indian and Atlantic oceans between Perth and London, embraces the following works, viz:—

1.—Cable from Western Australia *vid* Cocos Island and Mauritius to South Africa, with branches to India and Singapore—9,100 miles.
2.—Cable from South Africa *vid* Ascension and Barbadoes to Bermuda, thence to Canada and the United Kingdom—6,600 miles.

These two sections together make 15,700 nautical miles, while the distance from London to Perth by the Canadian route is about the same, the actual distance being a few hundred miles less. Thus it will be seen that taking into account branch cables to connect all the British possessions, half the whole work is already or will shortly be accomplished.

Since the projected Imperial postal cable service was formally submitted to the Secretary of State for the Colonies in 1898, certain telegraph companies have been permitted to lay private cables on the sections east and west of South Africa: it may, however, be assumed that in a matter which has been correctly described as of transcendent importance to the British people everywhere, care has been taken, by those acting for the State, to reserve the right to expropriate these cables, whenever in the public interests they may be required.

The papers appended set forth the scheme in detail, and furnish ample explanations on all essential points. These documents contain the matured judgment of Sir Sandford Fleming, a member of the board, who has given more attention to the subject than any other man, and in whose views this board entirely concurs. In one of these appendices it is pointed out that it was largely owing to the action and influence of the Chambers of Commerce of the United Kingdom that the Postal Telegraph Service was introduced 30 years ago in the Mother Country. Similarly, we believe it to be in the power of the various bodies representing trade and commerce throughout the Empire to influence the universal adoption of the Imperial postal cable service. It is with that object in view that this appeal is made. We respectfully and earnestly invite the aid and co-operation of all such bodies in bringing to completion "the crowning development of the British Post Office."

In the name and by the authority of the Board of Trade of the capital of the Dominion of Canada, we ask all concerned in this Imperial movement to take such action as may tend most speedily to nationalise the telegraph system, by land and sea, of the whole Empire.

We have the honour to be,
Your obedient servants,
JOHN COATES, *President.*
CECIL BETHUNE, *Secretary.*

THE ECONOMY OF CONDENSING ENGINES.

By W. H. BOOTH.

If it were obligatory upon steam engineers to carry full boiler pressure throughout the stroke, then would the economy due to condensing working be represented approximately by the ratio $N : (N + 1)$ where N is the number of atmospheres of boiler pressure. This would represent the maximum economy with a perfect vacuum, and the real ratio would be less favourable according as the vacuum fell below the maximum. Taking an actual case with steam at 147 lbs. and the application of a full vacuum of 14·7 lbs., would increase it to 161·7, the ratio of consumption being $10 : (10 + 1)$, or 10 per cent. more power from the same strand. If, however, the boiler pressure of 147 lbs. represents 12 times the attained vacuum, the new economy ratio will be 12 : 13. A century ago or less steam boilers were worked at a pressure of half an atmosphere, and the application of vacuum gave an economy ratio of $0·5 : 0·5 + 1·0$, that is to say, the same steam resulted in the production of three times the duty. We have, of course, here neglected the modifying effects of cylinder action. Still the principle is clear that condensing working results in much greater economy where the mean steam pressure is small than where it is large. Thus it is that the economy is less where high pressure steam is used than where pressures are low.

But even where there is a mean pressure of 45 lbs. referred to the L.P. cylinder the addition of a further 13 lbs. will enable the same steam to do so much more duty, and even with high pressure steam the mean cylinder pressure is often comparatively small, and there will be few cases where condensing will not show a large return. In electric traction work particularly the mean forward pressure is low. This is particularly marked when compound engines are employed, because such engines on a widely varying load are so much too large for their mean duty. It follows, therefore, that the effect of condensing must be considerable in traction work, and that it will give large returns on the capital invested in the necessary plant, especially if condensing be provided in the original design, and the rest of the plant be made as much less as it may be, and so much of the expense of the condensing plant is saved.

This is obvious, if we consider that with a boiler pressure of 150 lbs. the mean pressure of a fully-loaded compound engine (*i.e.*, fully loaded at the peak of the load) may only be 30 lbs. To such an engine the addition of a condenser would mean a very large addition of duty from the same fuel consumption. It may sometimes be noticed that condensing engines on a traction load will race at the periods of small load. This is a somewhat common fault, and it is due to the fact that the automatic expansion valves do not close so far as to shut off steam entirely, and the mean forward pressure in the engine cannot fall so low as to be balanced by the resistance.

The remedy for this is to arrange the cut-off so as to entirely shut the steam admission at no load or light load. If this is done the engine can pump up vacua on both sides of the piston of such intensities that their difference is just the driving effort equivalent, and there is no racing. Similarly for traction work, or, indeed, for any work of a widely varying range, there should be a variable automatic cut-off to both cylinders. The reasons why this is advocated are that when the load is reduced the low pressure cut-off bottles up the steam in the engine, and when the load again comes on, the engine is full of steam ready to deal with the load. If, on the other hand, there is no variable cut-off to the low pressure cylinder, this cylinder depletes the whole engine of steam when the H.P. cut-off acts, and when load again comes on, the engine is not ready to take it up, but slows down until it is again charged with steam through the high pressure valve. This reasoning must not be taken to apply to engines on steady load, which do not usually require the double cut-off because they do not pass through the foregoing cycles of surfeit and depletion. It is very usual to find the low-pressure cut-off fixed at a little earlier than half-stroke on the ground that the point has proved good in many economical engines. This may be so, but then most of these fixed low-pressure cut-offs have proved themselves good on steady loads only, and for a widely varying load there are other considerations than economy alone, and we doubt the special value in this direction, except where the load is fairly steady. Similarly a throttling engine may show good results for steady loads, but can hardly be applied to traction loads The lag and lead of the effects of the steam already in an engine are not perhaps of very great account in high-speed engines, but where the American practice of slow speed is adopted we have seen the enormous and wasteful fly-wheels that are necessary to deal with the speed fluctuation. In half a second there may be such a rush of current as to work the circuit breakers of a high speed set. In half a second, a slow-speed engine has not made one revolution. Hence the need of large fly-wheels. In a high-speed engine, in fact, the fly-wheel has got to take care of the variation of crank turning moment in a very small fraction of time, for in that fraction the acting impulse of the steam is equated to the resistance.

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In slow-speed engines it takes much longer to vary the steam impulse, and it may happen that this is varied only to find that after all the change, or the necessity of the change, has been cut out by another and opposite load variation. Thus, in slow-speed work, we have to sacrifice a lot of energy in fly-wheel friction to counteract the effects of long cycles in the engine itself, and it must constantly happen that a movement of the governor will occur that varies the steam pressure in a direction contrary to what the mean variation would have been in an engine at a much higher speed.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION (GLASGOW CONVENTION).

REFUSE DESTRUCTORS IN COMBINATION WITH ELECTRIC POWER STATIONS.

Abstract of Paper read by J. S. HIGHFIELD.

Electrical engineer, St. Helens Corporation.

IN writing this paper the author has found himself in a somewhat difficult position. He endeavoured to gain such knowledge as would enable him to write of plant other than the one for whose operation he is responsible, and so arrive at more general conclusions. He found, however, that the knowledge he could gain of other plant was exceedingly limited, and so he has kept to his original idea that nothing but personal working experience is of any use when writing on this subject, and at the risk of narrowing the issue, he decided to deal only with the plant whose working he controls, and draw general conclusions to but a limited extent.

It is absolutely certain that in most towns—in all but coast towns, there is no better method of getting rid of town refuse than by cremation; and the primary object of every destructor must be to cremate the refuse in a perfectly sanitary manner.

In towns having 100,000 inhabitants or more it will generally be more economical to have two sites, and in very large towns more than two sites, as any saving that can be made by burning all the refuse in one large central destructor is more than counter-balanced by the extra cost of carting. In St. Helens there are two destructors; the cost per ton of carting to No. 1 is 2s. 6½d., and to No. 2, 2s. 6½d.; if all the refuse were carted to No. 1 the cost per ton would be 2s. 11d. The policy of the Committee responsible for the cremation of refuse must be decided very largely by this question of cartage, taking into account the value of the refuse as fuel to produce steam for the power station, which value will be treated of later in the paper.

In considering the question of site, where two or more destructors are necessary, and where no power station already exists, it is advisable to place the largest destructor on a site also suitable for the power station, and to choose this site so that the cartage shall not be very heavy from the districts where the refuse having the best fuel value is obtained. If a power station already exists and the site is sufficiently large and in a sufficiently favourable position from the cartage point of view, then, of course, this is the position for the refuse destructor.

THE DESTRUCTOR.

Without the addition of boilers there are certain points that should obtain in any really first-class destructor. These points may be tabulated:—

1. Forced draught.
2. A suitable arrangement of duplicate flues.
3. Quick charging appliances.
4. Baffling chambers or other devices to prevent dust entering the chimney stack.
5. Arrangements for quickly and cheaply removing the clinker.

If, in addition to the destruction of the refuse, steam raising on a serious scale is contemplated, it is further necessary to provide:—

1. A high-pressure boiler in connection with each furnace, of which there must be at least two, one as a stand-by.
2. Each furnace must have two divisions or cells, one of which must always be in full blast when the other is being clinkered or charged.
3. Bye-pass flues, so that any surplus heat can be sent direct to the chimney.
4. Arrangements to prevent cold air getting to the boiler during charging and clinkering operations.
5. Duplicate flues to enable the furnaces to be worked continuously from week to week, one set of flues being cooled down for the necessary periodical cleaning operations.

Generally when a destructor is used as an adjunct to an electric power station, a separate grate is provided so that coal can be burnt under the boiler. This is only necessary when it is contemplated to steam the boilers without refuse, that is with coal only, or when the refuse is of extremely variable quality. The writer has never yet used coal to help out the destructor fires, but occasionally the refuse is of poor quality and then it is necessary to help the destructor with steam from other boilers. He has found it a good plan to burn the clinker and ashes from the electric works boilers in the destructor when the refuse consists largely of fish or paper; by this means he burns these substances in a better manner, and gets more steam and also gets rid of a waste product in an economical way.

Referring to the details above mentioned, the most important so far as steam production is concerned, is a rapid means of charging and clinkering the furnaces.

The flue as above mentioned must be duplicated or arranged so that the furnaces need never be shut down, and the forced draught arrangements should be also duplicated; in short, all the usual arrangements made by engineers to obviate a shut down at the power station must be made in connection with any destructor designed to supply steam to its engines.

Having noted the above general considerations, it is necessary to consider the conditions of steam production from a destructor, and the first point is that the steam is produced steadily for at least 16 hours, and possibly for 24 hours each day. It is not in any way desirable to operate the destructor to follow, for instance, the variations of a lighting load: if a lighting load only is to be worked, and the day load is small, the use of a destructor is limited to the working of only a small part of the load. In the case of direct-current plant, a large storage battery is a most useful adjunct in this respect as in others; it enables the plant load factor, and hence the utilisation of the steam, to be greatly improved.

If a lighting station only is to be supplied, the remarks above as to the addition of an extra grate for burning coal do not apply. The correct way to design the destructor in such a case, is to erect a boiler considerably too large for the destructor to steam alone to its full capacity. When the heavy load comes on, coal may be burnt in the second furnace to drive the boiler to its full capacity. The writer regards such an arrangement, however, as only suitable for small installations; in such cases it would be very useful.

If, however, the steam is used in connection with a traction station, or a station which supplies energy for both lighting and traction, then the destructor steam can be put to very much better use.

The plant of which the writer has charge consists of two Beaman and Deas' furnaces, each divided into two cells, each furnace serving to steam, to its full capacity, a Babcock boiler with 1,470 sq. ft. of heating surface. The forced draught is provided by an 18-H.P. motor-driven fan, the average pressure in the closed ashpits being 3 in. the water-gauge. The plant at the power station consists of five steam generators of a total output of 1,000 KW. In addition to the steam from the destructor boilers, steam is supplied from a battery of four 30-ft. × 8 ft. Lancashire boilers. The steam ranges are designed so that two steam sets, each of 125 KW. capacity, can be run from the destructor independently of the other boilers, or the destructor boilers and Lancashire boilers can supply the whole range in parallel; in each machine circuit, a watt-hour recording meter is fixed to meter the output from the generator. The usual practice is to drive one or both of the 125 KW. sets from the destructors only, for a part of the day, and later on when more plant is required, to parallel both sets of boilers on the whole load.

The working this year has been somewhat interfered with from the usual causes incident to any new installation; a considerable amount of alteration and reconstruction has been done, which has prevented the fullest efficiency of working being attained.

It was found that the calorific value of the fuel was distinctly better in the summer than in the winter. The refuse varies somewhat from day to day, and, therefore, if no other boilers were available, it would be necessary occasionally to use coal under the destructor boilers, or to hold a reserve of boiler ashes and clinker to use when the calorific value of the refuse was poor.

The figures relating to 12 months' working from March 31st, 1900, to March 31st, 1901, are as follows*:—

From the above figures it will be seen the net saving to the destructor department, due to combining the electric works and the destructor works, is £450, less £50 on boiler repairs, and less the interest and sinking fund charges on £1,500 (which represents the extra capital cost on the boiler plant above what would have been necessary for smaller boiler plant for working the mortar mills, the blowing fan, and other plant on the works), which may be taken as £90, leaving £310, or 41 per cent. of the total wage bill. The cost of cremating the refuse, and removing the clinker, is therefore reduced from 2/6·6 per ton to 1s. 11d. per ton.

It should be noted here that, in addition to supplying steam to the electric works, the destructor also supplies steam to drive two mortar mills and a steam winch.

Considerable care was taken to prevent dust from the destructor getting into the power station; it is almost impossible to do this quite successfully, but no serious harm was done by the small amount that did enter.

BRAKING APPARATUS FOR ELECTRIC CARS.

By A. L. C. FELL,

Tramway Engineer, Sheffield Corporation.

THE various methods of braking cars on electric tramways call for serious consideration owing to the comparatively high speed at which electric cars travel through crowded thoroughfares, and also, that cars may be safely handled on steep gradients. On railways, a fairly good rail can always be relied on, but in street tramway work the state of the rails is very unreliable.

Car brakes may be classed under six different headings, viz:—1. Hand brakes; 2. Friction brakes; 3. Slipper brakes; 4. Pneumatic brakes; 5. Electro-magnetic brakes; 6. Newell electro-magnetic brake.

Hand Brakes.—The best known of these is the link suspended type, the links being set at a slight angle so that gravity will tend

* These figures can be found in our comments on Mr. Highfield's paper on another page.—EDS. ELEC. REV.

and co-operation of all such bodies in bringing to completion "the crowning development of the British Post Office."

crank turning moment in a very small fraction of time, for in that fraction the acting impulse of the steam is equated to the resistance.

to keep the shoes away from the wheels when they are not in operation. The shoe and head are usually of the well-known "Christie" pattern, the shoes being retained in the holders by means of a pin which can be easily removed when the shoes require replacing. The brake beams and equalising brake beams are placed with their surfaces against each other, the power lever being the fulcrum at their centres. In the majority of cases the brake rods are made in one piece, thus avoiding unnecessary swivel joints. The link suspension is claimed to give much freer movement, as it does not become clogged with either mud or ice. In the writer's opinion there is not any particular advantage to be gained by using one particular type as compared with another. The chief point in connection with all brakes is that reliable men should be employed to fit them on to the wheels of the cars so as to ensure even pressure on the wheels. One very important matter concerning the adjustment of brake rods is not to employ locking nuts, as they cause serious delay when this work is necessary. The adjusting nut should be kept in position by a pivoted claw which can be simply thrown back when it is necessary to move the nut.

The writer has tested various types of brake shoes, and finds the "Corning" brake shoe is the best. This shoe, although somewhat more expensive in first cost, has been found to last several times the life of an ordinary cast-iron shoe without materially affecting the wear and tear on the wheels. The main body of the "Corning" shoe is of tough hard iron cast about a soft grey iron core. The body of the shoe has a chilled face. The combination of the chilled iron body and the soft iron inset makes the frictional quality almost equal to that of ordinary cast-iron. The wearing qualities of this combination appear to give splendid results. A sample of one of these shoes is shown. This ran over 12,300 miles on a route where the gradients are very steep, viz., 1 in 11 and 1 in 12, and would easily have run another 1,000 miles before replacement would have been necessary. Ordinary hard cast-iron brake shoes on another car on the same route only ran for 6,000 miles before they were worn out. The difference in the diameters of the wheels under the two cars was inappreciable. Tests are now being made with various types of brake shoes on steel tyred wheels, but at the time of writing comparative results cannot be given.

Friction Brakes.—On cable cars or on electric cars, where only one motor is used, or where a broad gauge is in operation, a friction brake can be operated. This consists of a spool or boom upon which a chain is wound, the chain being attached to the brake lever and the spool or boom driven by two friction plates operated by the driver through the medium of a lever, a slight pressure on which applied by the hand or foot instantly applies a very effective brake. This type of brake acts very rapidly in the case of an emergency; it is simple in design, cheap to obtain and to operate, its only objection being the amount of room required to properly mount it on the axle. For this reason, on the majority of tram roads in this country, it could not be used.

Slipper Brakes.—This is the most useful type of brake at present in operation in England, and simply consists of wood blocks which are pressed down on to the rails by means of levers. The levers are operated by means of a hand wheel connected by a chain or worm gear at either end of the car. The operating hand-wheel is fixed on to a tube spindle, which is placed outside the solid hand brake spindle. The two spindles are quite independent of one another and separate ratchets and pawls are provided for locking them independently. It has been found in practice that it is advisable to design the slipper brake operating hand-wheel so that it is impossible to lift the car off the rails. The framework carrying the slipper brake shafting, levers, and slides is fixed to the sides of the truck frames. On all gradients steeper than 1 in 20 it is advisable to use the slipper brake, and the best results have been obtained when the slipper brake is worked as an auxiliary to the hand or electric brake. On single lines with steep gradients the slipper brake is especially useful as it not only retards the descending car, but also cleans the rails for the ascending cars.

Pneumatic Brakes.—On several systems in this country pneumatic brakes are fixed on the cars, but in the writer's opinion they are not satisfactory since they are not always reliable. They require complicated and perfectly fitted mechanism to compress the air; the cost of maintenance is very high, and the conditions under which a street car has to work are unfavourable to success on account of the mud, dirt and dust under the car. The air, which is compressed, has to be drawn in under very unfavourable conditions, and the dust rapidly cuts up the cylinder of the air compressor. The difficulties in connection with driving the air compressor and keeping up a sufficient supply for frequent stoppages, are problems which have not yet been satisfactorily solved.

Electro-Magnetic Brakes.—One type of this brake consists of two cast-iron discs, one of which is fixed to the motor and has a coil of wire wrapped round it, the other is keyed to the axle. The motors are used as generators and gradually short circuited through a rheostat and the disc coil above mentioned. The discs are thus magnetised and braking action is produced from three causes:—

1. Retardation due to converting motors into generators by driving them from the car axles on practically short circuit.
2. Drag due to eddy currents which are set up in brake disc as it revolves in the intense magnetic field of the brake shoe.
3. The mechanical friction between the brake disc and shoe.

As the braking effect is so rapid, great care has to be exercised not to magnetise the discs too quickly, otherwise the wheels will at once be skidded unless a very plentiful supply of sand is used. On a good rail this type of brake can be used for taking a car down a gradient 1 in 11, but it is always safer to use a slipper brake in conjunction with the electric brake. In practice it has been found advantageous to bring the slipper brake into operation at the top of a gradient and fix it, the speed can then be regulated by the hand or electric brake. In the writer's opinion the hand brake should never be used in conjunction with the electric brake, but, if the former is in use, it should be released before the electric brake is applied.

The Newell Electro-Magnetic Brake.—This is arranged to act as a magnetic slipper brake, the slipper being made of cast-iron, and having coils wound round it. The method of magnetising the slipper is similar to that employed to magnetise the disc brake described above, but in this case the slipper is drawn down on to the rail, whereby a strong braking action is set up. The writer has not had an opportunity of practically testing this brake on a roadway, but the experiments made at the Tramways Exhibition in London in 1900 were very satisfactory.

Brake Tests.—Tests have been made to ascertain the best methods of stopping cars under various conditions. Cars were run over a marked-off space on a practically level road. The speed was in each case carefully noted, and the brakes were applied at the same point in each case. The results are tabulated in the Table. From the results obtained and from previous experience it appears that for all-round general purposes the hand brake worked in conjunction with the slipper brake is the best and most reliable method of regulating the speed of a car. This is especially the case if the rails are greasy, because the wood block thoroughly cleans the rail. For emergencies the electro-magnetic disc brake is the most satisfactory, but it requires to be applied very carefully, as it is very liable to cause skidding. The constant use of electric brakes is not to be recommended, because:—

1. They are expensive items, and the wear and tear is very excessive.
2. When the gradients are very steep, the life of the motors will be appreciably shortened, as they will never get an opportunity to cool down.

BRAKE TESTS.—*Hand Brake Only.*

Date.	Time secs.	Speed miles per hour.	Distance travelled before braking.	Distance travelled after braking.	Remarks.
1901.					
March 12th	24⅔	12·88	461 ft.	61 ft. 02 in.	Rail greasy.
"	27⅔	11·47	461 "	63 " 0 "	"
"	30	10·48	461 "	43 " 0 "	"
"	21⅔	14·68	461 "	77 " 0 "	"
"	32	9·83	461 "	41 " 0 "	"
"	21⅔	14·68	461 "	120 " 0 "	"
"	21	11·16	344 "	57 " 0 "	"
"	22	14·29	461 "	35 " 0 "	"
"	22	14·29	461 "	69 " 0 "	"
"	25	12·57	461 "	32 " 0 "	Rail dry, no sand.
"	28	11·22	461 "	31 " 0 "	"
April 19th.	20	14·42	423 "	49 " 6 "	"
"	20	8·28	243 "	59 " 0 "	"
"	19⅔	14·86	423 "	54 " 6 "	"
		Slipper Brake Only.			
March 26th	27	11·64	461 ft.	74 ft. 6 in.	Rail dry, no sand.
"	27	11·64	461 "	96 " 10 "	"
"	25½	12·32	461 "	102 " 6 "	"
April 19th	20	14·42	423 "	132 " 0 "	"
"	20	14·42	423 "	102 " 9 "	"
"	15	10·04	243 "	125 " 0 "	"
		Electric Brake Only.			
March 26th	25	12·57	461 ft.	88 ft. 0 in.	Rail dry, no sand.
"	25	12·57	461 "	46 " 0 "	"
"	18⅔	12·6	344 "	55 " 9 "	"
"	26	12·08	461 "	73 " 6 "	"
*April 19th	22	13·10	423 "	147 " 0 "	"
† "	20	14·42	423 "	105 " 0 "	"
‡ "	12	13·80	243 "	120 " 0 "	"

* Electric full. † Electric varying. ‡ Electric varying.

THE CONVERSION OF DIRECT INTO ALTERNATING CURRENT FROM THE ELECTRO-CHEMICAL STANDPOINT.

THE recent work of Simon, Duddell, Peukert, Ruhmer, &c., on current variations in the electric continuous current arc has, it would appear at first sight, but small direct interest to the electro-chemist. Still, on more careful examination, it is clear that this is not the case, and that it is to electro-chemical science that one will have to look eventually for an explanation of many of the curious phenomena discovered by these investigators. Duddell pointed out that the necessary condition for the conversion of direct current into alternating current in the arc is that the $\frac{\delta V}{\delta A}$ of the arc should be negative, that is, with an increase of current the

Referring to the details above mentioned, the most important so far as steam production is concerned, is a rapid means of charging and clinkering the furnaces.

* These figures can be found in our comments on Mr. Highfield's paper on another page.—EDS. ELEC. REV.

voltage should decrease. This naturally holds good for all cases, and every circuit possessing a negative $\frac{\delta V}{\delta A}$ can, under the proper conditions, be made to act as a converter for transforming direct into alternating currents. The bearing of electro-chemistry upon this is in the fact that electrolytic conductors are such with which a negative $\frac{\delta V}{\delta A}$ is particularly easy to realise. The designation of $\frac{\delta V}{\delta A}$ as the "resistance" of the circuit, and its consequent "negative resistance," is, we think, misleading as a resistance, being of the nature of a friction, is by definition positive. The point now arises, How can a negative $\frac{\delta V}{\delta A}$ come into existence?

The simplest explanation would be that, in consequence of the increase of current δA, such a change is brought about in the chemical or physical properties of the circuit that an abnormal diminution of resistance occurs, this diminution being so large that the resultant resistance, multiplied by the increased current, gives a value for the voltage less than its value was before the change of current, δA, occurred. A simple calculation will illustrate this. Assume a conductor having 10 ohms true resistance; we send a current of 10 amperes through it and the voltage fall over the conductor is 100 volts. The current is now increased to 11 amperes, and the following cases can be foreseen:—

1. The resistance rises to 11 ohms $\therefore$ voltage = 121 volts and

$$\frac{\delta V}{\delta A} = \frac{21}{1} = +21.$$

2. The resistance remains constant $\therefore$ voltage = 110 volts and

$$\frac{\delta V}{\delta A} = \frac{10}{1} = +10.$$

3. The resistance diminishes to $\frac{100}{11}$ ohms

$$\therefore \text{voltage} = \frac{11 \times 100}{11} = 100 \text{ volts}$$

$$\therefore \frac{\delta V}{\delta A} = \pm 0.$$

4. The resistance diminishes to less than 9·09 ohms to, say, 8 ohms

$$\therefore \text{voltage} = 11 \times 8 = 88 \text{ volts}$$
$$i.e., \delta V = -12$$
$$\therefore \frac{\delta V}{\delta A} = -12.$$

We thus see that a diminution of resistance sufficiently great causes the $\frac{\delta V}{\delta A}$ of above circuit to appear as a negative quantity. Now as a rule, with conductors of the first class (metallic conductors), providing they do not change in shape thereby, with rise of temperature, a rise of resistance also occurs. With conductors of the second class (electrolytes), however, a rise in temperature is connected with a fall in electric resistance, due to the greater electrolytic mobility of the ions when hot. As the passage of electricity in both cases causes a liberation of heat, we see, *ceteris paribus*, only an electrolytic conductor can give us what we desire. Other effects may, however, superimpose themselves upon the above and cause some complication. If under the influence of the rise of current, for some reason or the other the conductor becomes, for example, shorter and broader, its resistance would fall as a consequence. The experiments of Duddell demonstrated in a striking manner the extraordinary sensitiveness of the shape and size of the arc to small variations in the current, and it is likely that this alone is sufficient to account for the negative $\frac{\delta V}{\delta A}$ found. As, however, it is probable that the conduction in the arc is electrolytic in character, we have the effect due to this also.

Turning now to the case of an ordinary electrolytic conductor, say, a water solution of sulphuric acid, we may inquire under what conditions will its $\frac{\delta V}{\delta A}$ become negative. If the current passed through be small in comparison to the amount of electrolyte, the warming effect of the former is very small, and with a change of current, therefore, the resistance is only very slightly changed, and the $\frac{\delta V}{\delta A}$ remains positive. If now the cross-section of the electrolyte be diminished and the current density increased, it is clear that a point will by-and-bye be reached where the $\frac{\delta V}{\delta A}$ will become negative. Of course, exactly where this point will be depends on the particular function which connects the chemical and physical properties with the temperature; in this case, however the electrolytic mobility of the ions present depends on the temperature, and also the number of ions. From these considerations we are led to the following construction:—A comparatively thin tube filled with a solution of H_2SO_4 in water, and surrounded with a heat insulating cover to prevent temperature inequalities equalising out. Through this a large current is sent, and on properly adjusting this the condition of negative $\frac{\delta V}{\delta A}$ should be reached.

Another, at least theoretical, possibility is offered by working about a point where the number of ions suddenly greatly increases with a rise in temperature. A small rise in current, therefore, because of the consequent heating, causes a great increase in conductivity and diminution in voltage, which, properly adjusted, would also lead to a negative $\frac{\delta V}{\delta A}$. We do not think either of these ideas has been carried out practically, but a case perfectly analogous to the sulphuric acid tube is presented by the filament of the Nernst lamp, with which, as is known, a series resistance is necessary to compensate for its negative $\frac{\delta V}{\delta A}$. It is hoped that the above considerations may be of help to a clearer understanding of the phenomena; they have also an important bearing on other electrolytic work, to which we hope to refer at another time.

THE MERCADIER MULTIPLEX TELEGRAPH.

THE recent experiments which have been carried out in England have brought into some prominence a system which has been before French electricians for some years. The inventor is Monsieur M. E. Mercadier, Professor at the Superior School of the Post and Telegraph Department of France, and a Directeur des Etudes at the Polytechnic School. The system cannot fail to be of interest to readers of the ELECTRICAL REVIEW, and no further apology is needed for the following brief account, which is founded on the writings of the inventor himself:—

The chief advantage claimed for the Mercadier multiplex is the increased capacity which is given to the telegraph lines. It is affirmed that upon a metallic circuit such as is used for telephonic communication, or upon a single line which is protected from the induction of neighbouring wires, a complete system of 12 transmitters will give an output of 600 to 700 messages per hour. Following on this characteristic there is a considerable economy of expense: first, because of the smaller number of wires necessary; and secondly, because of the comparative cheapness of the apparatus employed. As three Leclanché cells suffice for each transmitter, the cost of batteries is reduced to a minimum. The system can be applied to all circuits upon which it is possible to employ a telephone, and in addition, the system being based upon the employment of rapid induced undulatory currents, it is possible to utilise the same circuit simultaneously for another telegraph system with ordinary continuous currents.

advantageous to bring the slipper brake into operation at the top of a gradient and fix it, the speed can then be regulated by the hand or electric brake. In the writer's opinion the hand brake should

alternating current in the arc is that the $\frac{\delta}{\delta A}$ of the arc should be negative, that is, with an increase of current the

In all other systems of duplex or quadruplex telegraphy there is a direct connection between the various circuits employed, and this fact causes many difficulties which require incessant attention. The Mercadier system first sets out to overcome this difficulty in the following manner:—For the purposes of transmission, use is made of vibrating currents only, which, by their very nature, in accordance with the law of coexistence of small oscillations, can be superposed without confusion, and even cross one another without the need of employing any mechanism. Further, all the currents of a primary circuit are transformed into like vibrating currents induced in other circuits separated from the primary by means of insulation. Finally, each circuit is isolated from the others by means of insulating material, by induction coil wires, relays, and other differential apparatus. The system is destined to put into simultaneous relation (fig. 1)

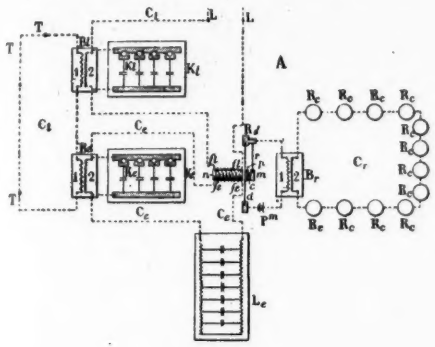

Fig. 1.

a telegraph or telephone line (metallic circuit L L), or a wire earthed at either end: first, with the transmitting circuit C *t*, in which it is possible to produce one or several sets of either ordinary currents, alternating currents, or undulatory currents of different frequency, by means of some apparatus T; second, with the receiving circuit C *r*, which includes the apparatus R *c*, capable of receiving the currents sent out by the transmitting circuit, and using them for the purposes of telegraphy, telephony, or some other purpose; and thirdly, with the extinguishing circuit C *e*, of which the *rôle* will be described later.

The relation between the line circuit C *l* and the transmitting circuit is established by means of the secondary wire (2) of an induction coil B *l*, the primary coil of which (1) forms a part of the circuit C *t*, the line circuit itself being completed by the wire *f l* wound on the core *n* of the electromagnet of a telephone which forms part of an apparatus R *d*, to be described later.

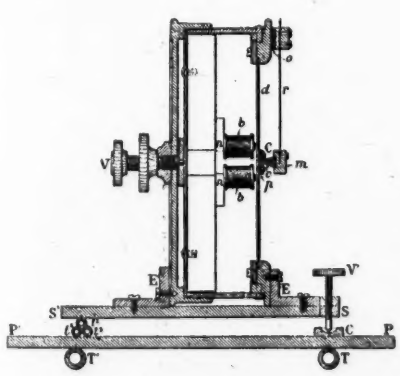

Fig. 2.

The relation of the line circuit C *l* with the extinguishing circuit C *e* is established by means of a second wire *f e*, similar to *f l*, and wound on the same core *n*. The circuit C *e*, in addition to the wire *f e*, includes the secondary coil (2) of an induction coil B *e*, identical with B *l*, and an artificial line L *e* formed of rheostats and graduated condensers. The primary coils of B *l* and B *e*, joined in series, form part of the transmitting circuit C *t*.

The relation of the line circuit with the receiving circuit C *r* is established by means of a differential microphonic telephone relay R *d*, and the secondary coil of an induction coil B *r*.

The relay (figs. 1 and 2) is formed (1) of a telephone, of which *d* is the diaphragm, and *n* the core of the electromagnet, on which are wound two identical wires *f l* and *f e*, which can afford a path in either direction for currents coming from a single source; (2) of a microphone composed of a plate of carbon *p* screwed to the diaphragm *d*; of a carbon contact *c* fixed on a metal block *m*, supported by a small flat spring R fixed to the frame of the telephone, and isolated from the apparatus by means of an ebonite plate *o* of variable length. A screw V permits the adjustment of the coils *b b* in relation to the diaphragm of the telephone. Two shoulders E E^1 fix the telephone upon a base S S, which is supported by means of a thick rubber tube t^1, which rests upon two other tubes t^2 t^3 fixed upon the platform P P^1. This platform further rests upon two rubber tubes T^1 T^1, and carries at one part a metallic groove C. A screw V^1, fixed to S S^1, allows the apparatus to be turned on the tube t^1 as a hinge, in such a way as to regulate the contact between *c* and *p*, and consequently the sensitiveness of the microphone. The rubber tubes serve to isolate the apparatus from vibration.

p m is the battery of the microphone; 1 is the primary coil of the coil B *r* of the microphone, and 2 is the secondary coil in which the receiving circuit C *r* is intercalated.

The system is completed by two graduated condensers; one K *l* joined in parallel with the line coil B *l*, and the other, K *e*, joined in parallel with the coil B *e* of the extinguishing circuit C *e*. It will be seen later that these condensers are of considerable importance.

Finally, the line L L (fig. 3) can connect two stations possessing the apparatus just described; and each of them

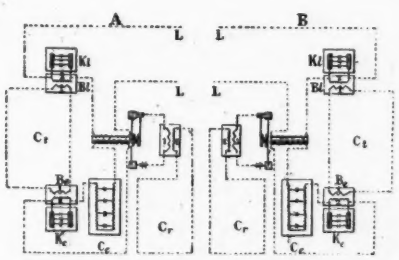

Fig. 3.

can transmit simultaneously or otherwise, by means of its transmitting circuit C *t*, currents which are in character either ordinary, alternating, or undulatory, and which will be received by the other station.

The system can thus serve a triple function. It will collect currents of various characters and transform them into mechanical energy by means of the telephone diaphragm. The system distributes automatically the currents arriving from the line, the movement of the diaphragm being reproduced in the secondary coil of the coil B *r* in the receiving circuit by means of the microphone and the primary wire (1). The system also extinguishes in the relay R *d* the currents produced in the transmitting circuit of the station where the relay is placed. These currents arrive in opposite directions and at the same time in the two coils B *l* and B *e*. If they are ordinary constant currents they are destroyed, if they are undulatory currents they have the same frequence, and they can even be adjusted so as to have the same phase by means of the condensers of the artificial line.

Such are the general outlines of the system, the nature of the apparatus being left undetermined. We will now describe the details of the apparatus employed.

is electrolytic in character, we have the effect due to this also.

simultaneously for another telegraph system with ordinary continuous currents.

The transmitter is represented schematically in fig. 4 with its relation to the other circuits. The inventor calls his transmitter an *electro-diapason inductophone*, which may be roughly rendered as an *electro-tuning-fork inductophone*. Fig. 4 shows only three of these *electro-diapasons*, in actual use there are 12. The electro-tuning-fork (fig. 5) is a tuning-fork kept in constant movement by means of an electro-magnet, E, placed between the branches of the instrument. This electro-magnet communicates on the one hand

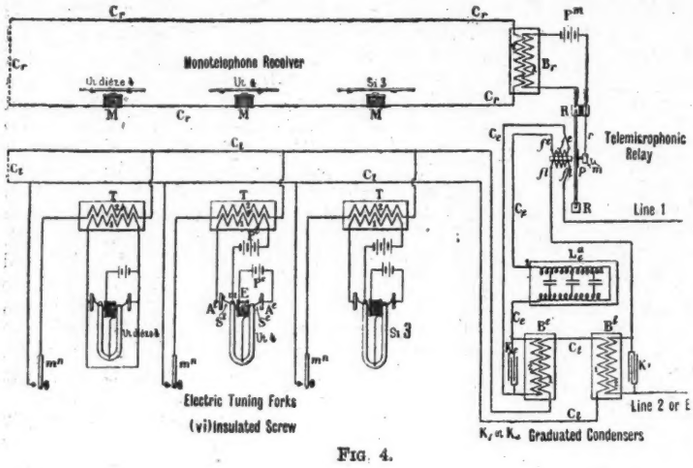

FIG. 4.

with the pole of a battery, P *e*, and on the other with the metal of the tuning-fork, and so with a steel point, S *e*, of suitable length fixed to one of the branches and opposite a platinum contact, A *e*, connected with the other pole of the battery. It is unnecessary to describe how this arrangement produces a constant vibration. A second point, S *t*, serves as a transmitting point, and is fixed to the second branch of the tuning-fork. It is isolated from the fork by a block of ivory. It is connected with the pole of another battery, P *t*, by means of an insulated aluminium wire, *f*, fig. 5. The other

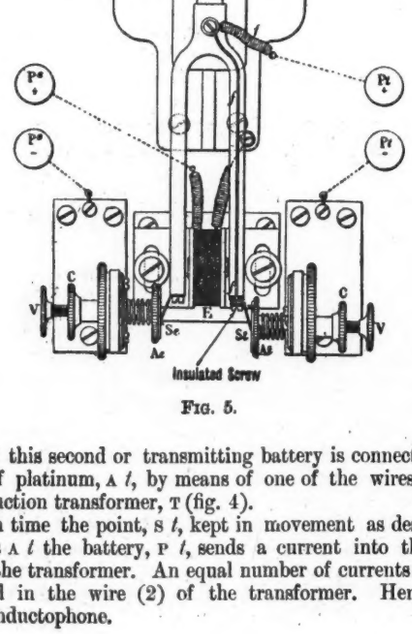

FIG. 5.

pole of this second or transmitting battery is connected to a plate of platinum, A *t*, by means of one of the wires (1) of an induction transformer, T (fig. 4).

Each time the point, S *t*, kept in movement as described, touches A *t* the battery, P *t*, sends a current into the wire (1) of the transformer. An equal number of currents is then induced in the wire (2) of the transformer. Hence the name inductophone.

In fig. 4 a simplified disposition is shown on the left-hand set, containing the electro-tuning-fork *ut dièze* (C sharp). The transmitting battery, P *t*, is suppressed and also the insulated screw, and the insulated wire *f*. The two terminals (P *t*, fig. 5) are connected on the one hand to the primary coil I of the transformer T (fig. 4), and on the other hand to the electro-magnet E. Thus we get a vibrating current derived from the battery P *e* in the primary coil of the transformer. When the resistances of this coil, and of the coil E, are nearly equal, the intensity of the currents is sufficient for the good working of the system, even on long lines, as, for example, when the battery P *e* is composed of two or three Leclanché elements of large surface. Further, by connecting metallically the terminals P *e* and P *t*, or the contacts A *e* and A *t* (figs. 4 and 5), the point S *t*, not being insulated from the tuning fork, if it should happen that the point S *e* gets broken, or the platinum A *e* gets worn, the movement is maintained by the point S *t* and the contact A *t*. There is thus a simplification, and in a manner an improvement of the apparatus.

Finally, each two of the transformers (fig. 4) is connected to the transmitting circuit through a key *m n* (fig. 4). Thus if one of the keys is depressed, a rhythmic intermittent current is set up in the transmitting circuit, and consequently in the primary coils, of the induction coils B *e* and B *l* (figs. 1 and 4). In consequence, however, of the sparking between the points S *t* or S *e*, and the contacts A *t* or A *e*, the current would rather better be described as an undulatory current, for the transmitting circuit is never quite interrupted.

(To be continued.)

BRAKING APPARATUS FOR ELECTRIC CARS.

THE M.E.A. paper by Mr. Fell on this subject deals with a matter of importance. Cars have grown more quickly than have the capabilities of brakes. Even the paltry four-wheel car, which is simply an overgrown horse-car, is immensely heavier than its prototype, and but little has been done to effectually brake it. The efforts of the motorman alone have been relied on with the result of producing, doubtless, a very muscular right arm, but a very poor braking effect, whilst for double track cars hand brakes are quite out of the field.

It will be noted that Mr. Fell condemns, and very rightly so, the use of lock nuts on brake rods, and recommends the pivoted claw. We have used this and can endorse his views. His appreciation of Corning brake-shoes will perhaps not meet with every engineer's agreement. Friction chain-brakes are not much approved, unless for wide gauges, which allow room for their employment. Indeed, the question of car brakes is greatly influenced by gauge. Air-brakes, for example, are difficult to apply, even to a 4-ft. gauge car.

Slipper brakes appear to have an effect beyond what accepted theory of friction would lead one to anticipate.

Obviously, as our author states, it must not be possible to raise a car off the rail by means of the brake. This, of course, is the trouble with a slipper brake, but Mr. Fell says that beyond gradients of 1 in 20 it is advisable to use slipper brakes. If this be so there are, we fear, a good many daily risks of disaster, for there are doubtless many steeper grades not yet worked with slipper brakes. Pneumatic brakes are not praised because they are unreliable. The air is drawn in dusty, and the internal mechanism soon cuts up. But surely it should be possible to draw in air through a suitable

C_1, in addition to the wire f, e, includes the secondary coil

filter. We admit, however, the complication of the air-brake and the cost of its compression.

Sufficient experience has perhaps hardly been acquired to enable a fair estimate to be formed of the electric brake, with its two cast-iron discs magnetised by using the motors as generators. This, of course, intensifies the wear of gears and does not improve motors. The author approves the Newell electric slipper brake. It seems to us that this brake acts on correct principles, for it avoids all chance of skidding wheels, and it is a fact that the limit of most brakes is the skidding of the wheel, a fault that the disc electric brake is very apt to produce. Our readers will note the author's conclusions in favour of hand and slipper brakes, and his cautious views as to electric brakes, but we can hardly suppose he would apply his remarks to electric slipper brakes *in toto*. If it could be safely devised the best brake would perhaps be an electric slipper worked by direct current from the trolley wire with an automatic emergency to act if the current failed. We fear that the uncertainty of the current or the certainty of de-wired trolleys puts a stop on this.

REFUSE DESTRUCTORS IN COMBINATION WITH ELECTRIC POWER STATIONS.

Among the papers read at the Convention of the Municipal Engineers' Association at Glasgow, is one on the above subject by Mr. J. S. Highfield of the St. Helens Corporation.

Mr. Highfield is eminently fitted to express an opinion on this subject as he has had under his control at St. Helens a destructor working in combination with an electric lighting plant.

In his opening statements he says that he has endeavoured to gain such knowledge of other similar plants as would enable him, by comparison with the results obtained under his personal observation, to arrive at some general conclusions in the matter. Unfortunately, however, the information he was able to obtain of similar plants was exceedingly limited, and he was, therefore, obliged to confine himself to the conclusions arrived at within his own personal experience.

Mr. Highfield obviously writes impartially, and his failure to obtain information as to the working of refuse destructors combined with electric generating plants is significant. We have from the first consistently maintained that the heat value of refuse must of necessity be so unreliable and so variable as to render refuse altogether unsuitable as a fuel for any such purpose as the generation of electrical energy for lighting or traction. Mr. Highfield comes to very much the same conclusion, he says:—"The primary object of every destructor must be to cremate the refuse in a perfectly sanitary manner." And again in conclusion, he gives it as his opinion that "in certain cases where a suitable site for a destructor and electric works exists, and where the works are not too large, combination could be usefully made when a traction or other good all-day load exists. For very large works, or for a station which only drives a lighting load, there are in many cases instances where there is an economy value in the combination." Mr. Highfield further points out that without desiring to generalise on this subject, he considers it better to use a destructor furnace to drive mortar mills or other machinery on which the calls are not so exacting as on an electric light plant.

As Mr. Highfield is responsible for the working of a combined destructor and electric light plant, his position as a critic is naturally an invidious one, more especially as the plant has been erected by the Local Authority. At the same time, the words quoted above, coming from such an authority as Mr. Highfield, are certainly very significant.

Mr. Highfield also refers to the question of the dust from destructors getting into the power station and causing trouble with the machinery. He says that in his own case he has been able to avoid any serious trouble, but from an engineer's point of view, it is difficult to conceive anything more irritating than to have in close proximity to electric lighting machinery a process, the invariable result of which is to make dust.

Adverting for one moment again to the question of the heat value of refuse, Mr. Highfield states that he finds the calorific value of the refuse distinctly better in summer than in winter. This is contrary to the usual experience, and serves but to accentuate the extreme unreliability of refuse as a fuel, and the truth of what we have repeatedly contended—that the results given by refuse in one district are no criterion whatever as to what can be obtained from refuse in any other district.

Mr. Highfield gives figures relating to 12 months' working of his destructor from March 31st, 1900, to March 31st, 1901. Such figures as these are of great value, and we reproduce them below. We have always expressed the opinion of the utter unreliability of eight or nine-hour tests of refuse destructors, and we have contended that the only way to get useful information regarding the performances of destructors is by tabulating the results for a period of at least six months, but preferably for a year, in order to bring into account the variation in the quality of the refuse during the various seasons of the year.

FIGURES FOR ONE YEAR'S WORKING OF A TWO-FURNACE REFUSE DESTRUCTOR.

	Total for year.	Average per week.
Weight of refuse burnt ...	9,778 tons	... 188 tons.
Electric energy used to drive fan and other motors ...	70,000 units	... 1,346 units.
Units generated by steam ...	365,000 „	... 7,019 „
Wages on burning	£750 ...	... £14 8s. 6d.
Wages on repairs	£86 ...	... £1 13s. 1d.
Total wages	£836 ...	... £16 1s. 7d.
Weight of clinker produced	3,900 tons	... 75 tons.
Value of mortar sold... ...	£221 9s. 8d.	... £4 5s. 2d.
Value of electric units generated at 3d. per unit generated	£450 ...	... £8 13s. 1d.

Averages per ton of Refuse Burnt.

Units generated	37·3
Units used on works	7·1
Cost of burning (including, wages, light and power)	22·1d.
Cost of repairs (wages and stores)	3d.
Total cost of destruction	25·1d.
Cost of removing clinker not otherwise used	5·5d.
Total cost of destroying refuse and removing part clinker...	30·6d.

The performance of these destructors from a commercial point of view is distinctly good. About 10,000 tons of refuse were burnt, and as a net result the cost of doing this and of removing the clinker was reduced from 2s. 6·6d. per ton to 1s. 11d. per ton, and it should be remembered that in addition to supplying steam to the electric works the destructor also supplied steam to work two mortar mills and a steam winch.

The discussion that followed showed clearly that a more correct impression of the value of a destructor as a steam raiser is prevailing among engineers and others interested in the subject. None of the speakers expressed any of the views that used so frequently to be heard not so very long ago on this subject. In fact, the bubble has been pricked with the usual result, namely, that nothing has been found in it, and we venture to hope that before long it will be universally recognised that the work of a destructor must be looked upon from a sanitary and not from a commercial point of view.

ELECTRIC MOTOR CARS AND TESTS.

By RANKIN KENNEDY.

Electric traction by storage cells seems to hang in the same backward condition. Strenuous endeavours have been made on the Continent of Europe to work tramcars by accumulators, the results, however, have proved that the system is too expensive in first cost, in electrical energy consumed, and in maintenance; these three items have proved too much for it in competition with the cheap and ready trolley wire.

Still there remains the road traction where no trolley exists, or is likely to exist; the propulsion of light vehicles for rapid transit over short distances, such as are covered by horse traps for business or pleasure, is a problem into which expense does not enter as the determining factor, for the competition is against other equally expensive motors.

induced in the wire (2) of the transformer. Hence the name inductophone.

surely it should be possible to draw in air through a suitable

Those engaged in this branch of electric traction have little to show for their efforts; hitherto inquiry into actual results of experience reveals no exact knowledge of the subject. So that whether the obstacle to progress is due to the battery, the motor, the gearing, or all the lot, one cannot say.

The test so often paraded as a wonderful result, is often only a ridiculous run of so many miles.

A car is fitted out by some parties interested in a battery, or in a motor, or in some new gearing. It is got into first-class running condition, full charged, and run till its very last kick—result, 50, 60 or 100 miles with one charge, a result we are expected to accept as a marvellous performance, and it may be so considered by "the man in the street."

But engineers look upon such performances as of little value to prove anything whatever. There are, of course, never any data given, no measurements of power expended or anything else.

Moreover, only a few enthusiastic monied people would ever for a moment contemplate returning to the old-fashioned highway road travelling of stage coach days; over such long distances, these long run performances of motor cars are demonstrations of endurance of material and workmanship (and of the motor driver), only if kept up long enough, which they never are.

What is required to be demonstrated is a car for handy work in and about town and for short excursions, always ready and fairly free from ailments.

In designing an electric motor car, we, of course, adopt the best motor, and the best gearing, and the best accumulator, *if we can*, and the question arises as to how we can ascertain which is the best; so far as the motor and gearing are concerned it is not difficult to arrive at an opinion of these if we are allowed a few simple experiments with them.

It is not, however, so easy to judge of the battery, although it should be easily tested, as follows:—

First, every battery has a certain capacity; a certain amount of energy which it can give out after each full charge and no more, this capacity should be found by accurate tests. It is often given by the makers and as often over-stated where traction cells are concerned.

Secondly, the battery should be weighed all full connected up, and the ascertained capacity divided by the weight will give the capacity per pound weight, a figure of merit for any battery.

These tests determine which battery will give the greatest power for its weight, and, other things being equal, must, of course, make the longest run with one charge; it is not necessary to put it on a car to prove this axiom. Hence the foolishness of the long-distance runs as tests of a car.

A battery may, however, give the greatest output per pound of its weight and yet cost too much in upkeep, we must therefore, make a test to ascertain the cost of maintenance. The cost of energy may be taken as the same for nearly all cells; it is in renewals of plates that cells differ so much.

This test can only be made in time by regular running under careful observation. Keeping a careful record of energy put into the battery, and energy taken out, the rates of discharge and the rates of charge, length of runs, and so on. The car should be first tested to find the power absorbed, by the motor, the gear, and the car, and these figures given with the others. The power taken on a known incline, should also be measured, also power on a level road with full load. It is necessary to obtain these data to know really what the battery has to expend in the work; without a knowledge of these easily ascertained facts no battery can be judged.

Every battery has a limited rate of discharge beyond which it cannot be worked without damage, and nearly every case of failure is due to the habitual running of cells over the safe limit of the rate of discharge. These car tests will determine the rate of discharge required for any given car, and the battery must be supplied to work up to this required rate, otherwise it will rapidly break down.

This is well known among battery people, but it is to be feared motor car people pay little or no attention to the point of utmost importance.

This point of carefully testing the car to ascertain the best rate of discharge required of the battery for it cannot be too strongly urged.

Having chosen the battery of greatest output per lb., and of proper discharge rate for the car, the next thing to do is to keep count of expenses for renewals and repairs over a period of time, in careful use under close observation by a competent observer.

A cheaply made plate, of course, will tell in favour of one even if it is less durable. In this way cost of maintenance per car mile will be obtained.

It may be said that in practice the battery will require to stand all sorts of rough usage; that may be, and the owner who roughly uses his battery will require to pay the penalty just as he would if he roughly used his horse. What we want to know, is the cost of upkeep under ordinary intelligent care, not what amount of abuse a battery will stand before breaking down.

All these points are of far more importance than the results of a senseless long run drive, such as we are treated to so often.

CURRENT SPECIFICATIONS.

LXXI.—BRADFORD TRAMCARS.

SUMMARY.

Extent of Contract.—Supply and delivery of *one hundred* car-bodies, trucks, and electrical equipments to comply with specification.

Division of Contract.—Offers may be sent in either for car bodies, trucks and equipments, or for complete cars.

Car.—To be of double-deck type, to seat 22 passengers inside, and 29 outside, mounted upon standard four-wheel trucks.

Gauge of Line.—4 ft.

Truck.—To be standard four-wheel truck with 6 ft. wheel base, complete with hand brake.

Trolley Pole.—To be of swivelling-arm type, 14 ft. long from centre of trolley wheel to centre of supporting standard,

Motors.—Two 30-H.P. four-pole traction motors to be supplied with each equipment.

Temperature Test.—Temperature rise not to exceed 130° F. after one hour's run at 55 amperes.

Overload Test.—To withstand 100 per cent. overload for one minute after machine has been running for one hour at full load.

Efficiency Test.—When two motors coupled together through their own gearing and run one as motor and one as generator, combined efficiency measured electrically at full load not to fall below 76 per cent.

Flashing Test.—2,000 volts maintained for five minutes on all insulated portions.

Controller.—To be of series parallel type fitted with rheostatic working and emergency brake.

Date for Completion.—Car bodies, two per week, commencing July 1st, 1902. Trucks.—50 during April, 1902, 50 during September, 1902. Electrical equipments.—25 on June 1st, 1902, 25 September 1st, 1902, 25 December 1st, 1902, and 25 March 1st, 1903.

Penalty for Late Completion.—£10 per day per section.

Terms of Payment.—90 per cent. as soon as possible after delivery of each 25 or larger lot, 10 per cent. after six months in case of car bodies and trucks, and 12 months in case of equipments.

Period of Maintenance.—Car bodies and trucks six months, electrical equipments 12 months.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be paid to Workmen.—Standard rates to be paid, see comments.

Arbitration Proposals.—Unsatisfactory, see comments below.

Date for Receipt of Tenders.—July 31st, 1901.

The specification is signed by Mr. C. J. Spencer, the general manager to the Corporation tramways. It is a sign of the increasing importance of tramway work in this country to find orders for quantities of not less than 100 cars at a time being placed.

The whole of the cars are to be of similar type, double-deck, suitable for 51 passengers each, and to be mounted upon standard four-wheel trucks. The wording of the specification as to the requirements of the purchaser are very clear, no special makers of any parts of the apparatus to be supplied are specified, and there should be little difficulty in meeting the specification with standard manufactures.

The motors, two of which are required for each car, are rated at 30 H.P.; they are to be of usual traction type, and definite tests as to temperature rise, efficiency and overload capacity are to be applied before acceptance. The controllers are to be of the rheostatic type with both working and emergency electric brake, and the lightning arrester and canopy switches of usual type.

The dates upon which delivery of the car bodies, trucks, and equipments are required are clearly given, the dates for

is to make dust.

competition is against other equally expensive motors.

different quantities falling between April, 1902, and June, 1903, and should these dates not be adhered to, a penalty of £10 per day per section will be enforced. The terms of payment are satisfactory, and the successful tenderer must undertake that he will pay during the period of the contract not less than minimum standard rates of wages, and that he has done so for a period of not less than three months.

This seems a fair stipulation; it guards the Corporation from any possible imputation of dealing with firms who pay excessively low rates of wages, and yet does not unduly interfere with the rights of the employer in respect of freedom to treat direct with his employés, without the intervention of third parties. In case contracts for parts of the work are placed abroad, it would be necessary in interpreting this clause to make allowances for the differences between British and foreign labour conditions.

The principal point to which exception should be taken by tenderers is the absence of an arbitration clause. All disputes are to be referred to the tramways manager, and his decision is to be final and binding upon both parties. This we consider very unfair, for reasons which from time to time we have fully stated, and we strongly recommend that stipulations be made in all tenders for the inclusion in the final contract of a clause similar in purport if not in words to that agreed upon between the representatives of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association, as embodying the principle of the final settlement of disputes by an independent third party.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

13,324. "Improvements in electric switches electrically controlled." C. SALMON and H. J. CREFFIELD. July 1st.

13,339. "A new and improved system of wireless telegraphy by means of stationary electrical waves." R. SCHARF. July 1st.

13,351. "Process of insulating conductors." C. E. WOODS. July 1st. (Complete.)

13,365. "Process of separating the matrices from galvano-plastically precipitated metals." C. E. STEINWEG. July 1st. (Complete.)

13,367. "Improvements in electric furnaces for dental and other purposes." R. WINTER and V. PAPPENHEIM. July 1st. (Complete.)

13,371. "Improvements in method of and means for tandem connecting a-synchronous alternating electric current motors." E. DANIELSON. July 1st.

13,372. "Improvements in alternating electric current induction motors." E. DANIELSON. July 1st.

13,402. "Improvements in self-exciting alternating current dynamos." M. LATOUR. (Date applied for under Patents, &c., Act, 1883, Sec. 103, December 13th, 1900, being date of application in France.) July 1st.

13,410. "Terminal block or pillar for connecting electric conductors." J. DUGDILL. July 2nd.

13,411. "Improvements in surface contacts for electric traction in streets or roads." C. SALMON and H. J. CREFFIELD. July 2nd.

13,415. "Improved holder for electric incandescent lamps." G. WALLACE. July 2nd.

13,431. "Improvements in the method of and means for electrically controlling a plurality of actions at a distance through a single conductor." J. GARDNER. July 2nd.

13,449. "Machine for producing perforated telegraphic paper." G. H. HACKETT. July 2nd. (Complete.)

13,468. "Improvements in electrical interlocking apparatus for railway signalling." THE WESTINGHOUSE BRAKE COMPANY, LIMITED, and E. DE M. MALIN. July 2nd.

13,478. "Improvements in electric railway with overhead conductors." C. BACH and K. RICHARD. July 2nd. (Complete.)

13,510. "Electrical workmen's time checking clock." C. T. MASON and S. R. BROWN. July 3rd.

13,513. "Improvements in electrical cut-outs." W. H. EVANS. July 3rd.

13,563. "Improvements in and relating to the transmission of electrical energy." H. H. LAKE. (N. Tesla, United States.) July 3rd. (Complete.)

13,568. "Improvements in plates for electric accumulators." D. TOMMASI. July 3rd. (Date applied for under Patents, &c., Act, 1883, Section 103, January 17th, 1901, being date of application in France.)

13,577. "Improvements in electrical fuses for high tension." P. LOESCHER. July 3rd. (Complete.)

13,583. "Improvements relating to electro-mechanical regulators." J. L. ROFFIN. July 3rd. (Date applied for under Patents, &c, Act, 1883, Section 103, December 22nd, 1900, being date of application in France.)

13,595. "An apparatus for holding paper for use on telephones by means of which calls may be readily recorded." H. CLEGG. July 4th.

13,623. "Improvements in push switches for electric bells." THE BRITISH THOMSON-HOUSTON CO., LIMITED, and A. S. CUBITT. July 4th. (Complete.)

13,624. "Improvements in the methods of securing and sealing electricity and other meters." W. C. BUSHBY. July 4th.

13,640. "Improvements in secondary batteries." J. BUFFAUD and A. TAVIAN. July 4th.

13,644. "An improved electrical resistance." H. H. LAKE. (G. G. Poncelin, France.) July 4th.

13,655. "Improvements in or relating to electric illuminating devices." A. J. BOULT. (J. M. Le Gall, France.) July 4th.

13,662. "Improvements in electrolytic cells." J. RASCHEN and THE UNITED ALKALI COMPANY, LIMITED. July 4th.

13,663. "Improvements in telephone transmitters." E. B. FAHNESTOCK. July 4th. (Complete.)

13,665. "Improvements in holders for Nernst lamps." E. G. SHEPPARD, G. S. RAM and NERNST ELECTRIC LIGHT, LIMITED. July 4th.

13,666. "Improvements in lampholders for electrolytic lamps." B. M. DRAKE and NERNST ELECTRIC LIGHT, LIMITED. July 4th.

13,723. "Improvements in life guards for electric cars and other self-propelled vehicles." A. ROYLE. July 5th.

13,732. "Method of and apparatus for effecting electric traction on tramways." C. D. ABEL. (La Société Anonyme pour la Transmission de la Force par l'Electricité, France.) July 5th.

13,738. "Improved means for preventing sparking at the collector of dynamo-electric machines." A. HEYLAND. July 5th.

13,747. "Page printing telegraph." G. MUSSO. July 5th. (Complete.)

13,802. "An improved trolley for electrically-driven tramcars and the like." B. J. B. MILLS. (L. Chapuis et Cie, France.) July 6th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

20,507. "Electric igniter for gas." H. von Arnswaldt. Dated October 12th, 1899. The ignition is effected by the incandescent wire of an electric torch, which is so constructed that the parts may be readily taken to pieces for repair and renewal. The apparatus is described with reference to drawings, and is too complicated for purposes of abridgment. 6 claims.

20,544. "An improved electric bell." R. Bowman. Dated October 13th, 1899. Bells suitable for use in mines are contained in a waterproof casing, and the hammer projects through a stuffing-box packed with a flexible diaphragm. The rod of a switch for converting the bell from a repeating to a single-stroke one passes through a similar stuffing-box. 5 claims.

20,587. "Improvements relating to electric railway conduit systems." H. S. Maxim. Dated October 13th, 1899. The body of the conduit is a shallow trough-shaped rolled or other section, and the slot-rails are made with depending flanges to fit on its edge, the inner flange being the deeper of the two. They are secured by pins or bolts which may be rendered more accessible by marking the adjacent sets or paving blocks and making them removable, or forming a passage through them. This passage may be lined and filled with sand. A channel or recess in the top of the slot-rail receives paving blocks or material, and some of the blocks may be contained in a metal casing to render them more easily removable. The lengths of the conduits and slot-rails are joined by fishplates. The conductors are of channel-section secured on T pieces held on an insulating car on a shank which is made in two parts connected by a metal sleeve squeezed around the meeting ends, insulating material being interposed. The shank may be screwed into the bottom part of the conduit, or held on its side. Or the shank may project through the side of the conduit, and be held by an insulator under a removable paving block. Or a rod of wood soaked in paraffin is clamped at its centre on the side of the conduit, and holds a conductor support at each end. Loose drain pipes, preferably flanged at their tops and trapped below, are placed in the conduit at frequent intervals. Transverse plates, which may be corrugated, are disposed in the foundation so that their inner ends lie under the conduit and their outer ends under the rails, to which they may be secured, and tie-bars connect the rails and conduit. At the points, the meeting sides of the conduit are partly removed, and as they diverge the sides are clamped by blocks and distance-pieces. 8 claims.

20,615. "An improved electric safety apparatus for lifts and elevators." J. Bush and A. D. Jenkins. Dated October 14th, 1899. This specification is too complicated for purposes of abridgment. 4 claims.

20,666. "Improvements in explosion motors." G. Richard. Dated October 14th, 1899. Governing: The exhaust is throttled in four-stroke cycle engines when the speed is excessive, and a smaller charge is consequently drawn in on the following suction stroke. Igniting: Two-cylinder engines have insulated plugs connected to the ends of the secondary circuit of an induction coil, so that when the primary circuit is closed by a cam sparks are produced in both cylinders between the plugs and the mass of the cylinder. In engines with cranks at 180°, however, the plugs are alternately short-circuited by a cam to prevent them from acting at the wrong time. 3 claims.

20,678. "An improved electric switch." R. J. Houghton. Dated October 16th, 1899. Switches for heavy currants, such as are used in electrolytic processes. Two metal contact blocks are separated by an air space or by insulating material. A nut working on a screwed stud is adapted to be rotated by a handle to be forced down, and make contact with both contact pieces. The stud may be carried by one of the contacts, or be insulated from both, or may be carried on a bridge-piece. Terminals are provided for connecting the conductors. 2 claims.

20,720. "Improvements connected with electric lamps having illuminating bodies composed of second-class conductors." V. I. Feony. (Allgemeine Elektricitats Gesellschaft.) Dated October 16th, 1899. A resistance for controlling the current supplied to a lamp having an incandescing body, which becomes more conductive when it is heated, consists of iron or other metal having a high temperature resistance coefficient, enclosed in a vessel containing hydrogen or other indifferent gas. The metal is used as fine wire formed into a coil of such dimensions that it is heated to low redness by the current for which it is intended. The vessel may be exhausted to increase the working resistance of the wire; this may be effected also by coiling the wire more closely. 3 claims.

20,743. "Improvements in electricity meters." J. Tourtel. (P. Ressler and P. Bauer.) Dated October 17th, 1899. An integrating meter contains an ampere-meter having a pointer, which is periodically returned to the zero of its scale by a crank on a wheel rotated uniformly by a clock or otherwise. The pointer carries a pivoted pawl, which is held in engagement with a ratchet-wheel, coaxial with the pointer, during the return motions of the pointer; the ratchet-wheel is geared to a counter, which sums the return motions due to successive deflections of the pointer. The pawl is so held by a bar on a frame, which is supported on fixed pivots, and is weighted so that the bar bears against a part of the pawl, unless the frame is turned away by a cam on the rotating wheel engaging its arm; the pawl is weighted to tilt away from the ratchet-wheel when freed by the bar of the frame, and is then free to move with the pointer as a part of the amperemeter. 3 claims.

20,751. "An improved device for steering electrically-driven motor cars." E. Andreas, H.Ph.D. Dated October 17th, 1899. Relates to the steering of motor cars driven by two electric motors separately driving the wheels of opposite sides of the vehicle. This is effected by causing the wheels to revolve at different speeds. To this end the field coils of one motor are placed in series with the field coils of the other, and the two armatures are connected in parallel, the switch arm acting as one terminal for the complete motor circuit. By moving the arm to right or left resistances are put in one or other of the two parallel branches of the armature circuit, thereby producing the desired differential action of the two motors. 2 claims.

20,753. "Improvements in lanterns or globes. Chiefly for incandescent gas-lights, arc electric lights, and the like." S. Sibeller. Dated October 17th, 1899. Lanterns for incandescent gas, electric arc, and other lights, in which it is necessary to obtain easy access to the interiors for cleaning, renewals, &c., comprise a globe mounted upon hooks suspended on chains, or the like, wound upon rollers. A counterbalance weight is similarly suspended by chains passing over pulleys and wound in the reverse direction upon rollers, smaller than and rigidly attached to the first rollers. When, therefore, the globe is raised or lowered, the cords are simultaneously unwound from one of the rollers and

rate of discharge required of the battery for it cannot be too strongly urged.

The dates upon which delivery of the car bodies, trucks, and equipments are required are clearly given, the dates for

wound upon the other, the difference in the sizes of the rollers causing the weight to pass through a less distance than the globe as they move in opposite directions. By turning the hooks through the ring the globe may be removed. 1 claim.

20,783. "Improved means and apparatus for regulating the speed of gas and like engines driving dynamo-electric machines." J. Richardson and F. S. Highton. Dated October 17th, 1899. The fuel inlet and air inlet of engines for driving dynamos are controlled by valves attached to the cores of solenoids connected with the dynamos. A beat-valve is carried on the end of the spindle of the fuel-valve, which falls and closes if the electric circuit is broken. The solenoid may be combined with a mechanical governor, and by omitting the valve the solenoid may be switched off when the engine is required for other purposes than generating electricity. A variable resistance coil may be inserted in the solenoid circuit to adjust the speed or electromotive force. 6 claims.

20,803. "Improvements in electric meters." The British Thomson-Houston Co., Limited. (E. Thomson.) Dated October 17th, 1899. An induction motor meter consists of stationary main current and pressure coils producing separate magnetic fields in which are two armatures carried by or geared to one spindle so that they rotate together. The armatures are interconnected, each consisting of a core surrounded by two or more coils, and each coil on one armature being permanently connected in a closed circuit with a coil on the other. If the field coils are all parallel, as shown, the coils on one armature are all displaced about the spindle from the connected coils on the other armature, the displacement being 45° if each armature carries two coils, or 60° for three. Otherwise each pair of interconnected coils may be in one plane, and one set of field coils placed at a suitable angle to the other. An inductive coil may be connected in series with the pressure coil between the mains. A starting coil, adjacent to the main current coil, is connected between the mains to compensate for friction. The spindle is geared to a counter, and provided with a magnetic or other retardin device. 11 claims.

21,378. "Combined maximum and integrating electric meter." E. S Halsey. Dated October 26th, 1899. (Date under International Convention, March 27th, 1899.) A motor meter of any kind having a brake disc is provided with a maximum-demand indicator. The armature shaft is pointed to bear on the cupped or flat end of an aligning shaft, which carries the brake disc. The two shafts are coupled, and their relative movements resisted, by a spiral spring connecting a tubular extension of the brake shaft with a flange on a disc on the shaft. Reverse relative movement is prevented by a gravity or other pawl on an arm of the brake shaft engaging ratchet teeth on the flange. The edge of the brake disc is graduated, and the flanged disc carries a flexible pointer, which may be pressed down to the brake disc, to afford an indication thereon of the maximum relative movement and load on the meter during any period. To prevent sudden relative movements of the shafts, the tubular extension is filled with viscous, tarry or resinous material around the lower part of the armature shaft. 19 claims.

21,413. "Improvements in safety fuses for electric circuits." J. Sachs. Dated October 26th, 1899. In cut-outs in which a fuse is enclosed within a casing, a second fine wire is arranged outside the case, which fuses when the main fuse blows, and thus serves as an indicator. The tubular casing is preferably closed by an end piece through which the pin terminals pass. The fuse may consist of a strip of foil on a piece of asbestos paper or the like. 5 claims.

21,429. "Improvements in or relating to incandescent electric lamps." C. Wolffhardt. Dated October 26th, 1899. A lamp cap of any kind is made with an internally-threaded extension to receive the threaded neck of an outer globe of any form. 1 claim.

21,470. "An automatic charging device for electric motor carriages." A. Muhlberg. Dated October 27th, 1899. Consists of automatic means for charging electric motor carriages at suitable stations without the necessity for switching resistance in and out by hand during the charging operation. To this end the carriages are furnished with trolleys or brushes which are adapted to make contact with conductors, at the charging-station, which conductors are in separate sections, and are connected with the generators through different resistances. During charging the carriage is caused to progress slowly under these conductors, with the result that the resistances are progressively reduced as the charging approaches completion. 2 claims.

21,562. "A separator for plates of secondary batteries." H. Leitner. Dated October 27th, 1899. Relates to separators for the plates of secondary batteries, and consists in constructing them of non-conducting material, such as ebonite, in the form of a grating having square or rectangular holes through it, arranged in vertical rows. One side of the separator is flat, so as to bear against and support the active material of the battery plate. On the other side are projecting semi-circular ribs, arranged so that when two plates are brought together, the ribs on one bear against parts between the holes of the other where there are no ribs. Two of the plates may be made by doubling a single plate along the middle, so as to take a battery plate between the folds, a hole being provided for the passage of the conducting-tang. The ribs may be flat instead of semi-circular, and adjacent separator plants may be cemented to the ribs of each other. Of two adjacent separator plates, one may be made without ribs, and be cemented to the ribs of the other. Two adjacent separator plates may be placed face to face in such a manner, that the holes through the two plates are not coincident. 2 claims.

21,637. "Electrodes for arc lamps." H. Bremer. Dated October 30th, 1899. Rods are made of angular sections, of mixtures of powdered carbon, with large proportions of powdered metals or metallic salts, to produce incandescent vapours, and with the addition of 1 per cent., or more, of boron, liquid flourine, or other material to render metallic accumulations sufficiently fusible to drop off the edges of the rods. The light may be coloured by a further addition of 25 per cent. of flourine, bromine, or iodine or magnesia. Opposite edges of the rods may be notched at intervals, to cause the breaking off of projecting corners if the arc burns inward. 4 claims.

21,650. "Improvements in systems of control for electrically propelled vehicles and trains." The British Thomson-Houston Company, Limited. (W. B. Potter and F. E. Case.) Dated October 30th, 1899. Relates to master controlling arrangements for controlling the motors and brakes throughout an electrically propelled train or on a single vehicle. Ordinary brake rigging applied by an electric motor is used. The construction of the controller and of the interlocking apparatus for its several switches are also described. A diagram of the master controller and of the motor controllers and brakes on one vehicle with all the cylindrical and other switches are shown developed in the drawings. Current is supplied from the trolley and the storage battery, charged from the line through resistances. The driving motors are controlled by the motor controller consisting of the resistances thrown in and out by the solenoids and by the reversing switch with series parallel operation worked by plungers and controlled by an electromagnetic lock. The motor operates a drum which applies the brake, and this motor is held at any desired point by a magnetic clutch. The master controller consists of the series parallel switch, the reversing switch, the magnetic clutch switch, and the brake motor switch, all of these being electrically interconnected. The series parallel switch is operated by a handle, and the other three switches are mounted on the same spindle, but the upper two are operated by cranks and links from handles. The upper ring of contacts on the brake motor switch is connected to the others by a pin and slot, and is held frictionally so as to have a different relation to them in the going on and coming off positions. The four spindles have cams attached, and these are engaged respectively by a hook and roller-ended levers pivoted on the casing. 23 claims.

21,651. "Improvements in electric railways and controlling devices therefor." The British Thomson-Houston Company, Limited. (W. B. Potter.) Dated October 30th, 1899. Relates to means for breaking electrometers, particularly in traction work, and for running them as dynamos to return energy to the distributing system. Four motors are arranged so that one of the armatures generates an exciting current for the fields of all four, and the other three armatures are coupled in series, and return energy to the line wire or other sources of supply, such as a battery. The arrangement of switches is described comprising a series-parallel controller of a usual type and reversing switches, and resistance and other switches which couple the motors and regulates the excitation and output. An automatic cut out voltmeter and ammeter are used in conjunction with the resistance switches to ensure that the voltage is sufficient. 10 claims.

21,652. "Improvements in methods of and means for synchronising electric motors." The British Thomson-Houston Company, Limited. (F. E. Case.) Dated October 30th, 1899. Relates to means for regulating or equalising the action of two or more motors connected in series; for example, in driving a railway car. When one of the two motor slips and its counter electromotive force rises a shunt circuit is established round this motor until the two motors are once more in synchronism. This is effected by means of an arrangement consisting of a pair of electro-magnets connected in series with each other round the two motors, and having a lead from a point between them to a point between the motors. Normally the two magnets are balanced in their action on an armature carrying a switcharm, but, when one or other motor slips, the balance is destroyed, and the switcharm establishes a shunt circuit round the slipping motor. This circuit includes a resistance which exercises a steadying influence. 14 claims.

21,653. "Improvements relating to the regulation of electric motors and to the brakes for electric railway vehicles and the like." The British Thomson-Houston Company, Limited. (F. E. Case.) Dated October 30th, 1899. Relates to means for utilising energy wasted in starting and running resistances used in connection with motors, particularly on electric railways, and to the brakes for the vehicles. The resistance is formed in whole or in part of a current-actuated motive device included as a step of the resistance. In one form, part of the resistance is shown in a series-parallel controller as a rotary motor which drives the air compressor for the brakes or may perform any other function. In another form, the resistance is formed as a solenoid, which draws in a plunger against a spring, and thereby liberates the brakes when the controller is thrown on. The spring serves to re-apply the brakes when the stops are worked by means of a right and left hand screw spindle operated by treadle gear so as to release gradually or wholly the wedge which retains the spring, in the compressed condition. 16 claims.

21,654. "Improvements in electric brakes and methods of operating the same." The British Thomson-Houston Company, Limited. (F. E. Case.) Dated October 30th, 1899. Relates to the braking of electrically-propelled vehicles. The method consists generally in applying the brake shoes from an auxiliary source of electromotive force (preferably a storage battery, though the line-wire may be used), and using the motors also to effect a retardation of the car. The two actions supplement each other, and are arranged to give a practically constant result. The motors may supply part of the current for the brake shoes, and may regulate the braking. In one arrangement the motors run as generators, and, as their current diminishes, the solenoid switch cuts out resistance in the circuit of the brake shoes and battery. In another arrangement the brake shoes and battery are in parallel with each other, and in series with a resistance in the circuit of the motors when they are running as generators, so that the battery is first charged and then supplies current to the brakes. The driver's controller includes the usual series parallel and reversing switches and a special brake switch for producing the conjunction described in the last modification. Two other modifications, with varying arrangements of the fields, armatures, &c., are also described. 13 claims.

21,655. "Improvements in systems of controlling electric motors." The British Thomson-Houston Company, Limited. (A. S. Garfield.) Dated October 30th, 1899. Relates to systems of motor control, especially for electrically-propelled trains. The electro-motors are independently controlled according to the indications of indicators or signals of any form, but preferably differential ammeters of the shunt type are used. The ammeter connected to the first motor or motors shows the current used therein, and all the other ammeters are connected to it by common leads so as to give the same indication, and the drivers then manipulate their controllers to supply sufficient current to their motors, so that the differential coils in their instruments will reduce the reading to zero. 8 claims.

21,656. "Improvements in controlling electric motors and electrically-propelled railway trains." The British Thomson-Houston Company, Limited. (E. A. Sperry.) Dated October 30th, 1899. Relates to a controlling system for a number of motors carried on separate vehicles, which are adapted to be mechanically connected together to form a train. A master controller is fitted on each vehicle, and all the motors can be controlled from one point. The controller consists of a master controller and a motor controller. The handles and electrical connections may be so arranged that the angular position of the controlling hand e represents also the angular position of the motor-controlling cylinder, which follows step by step the movement of the handle. The controller has three rings. On its shaft is loosely mounted a frame carrying three contacts, of which two are electrically connected, and the third is insulated from the others. The frame carries a contact, adapted to engage with a series of contacts disposed in a circle. An arm is fixed to the spindle and carries contacts connected to rings, and adapted to engage the contacts, according to the direction of movement. A set of contacts is connected to another set, over which a contact, carried on an arm of the motor controller, is adapted to ride. The motor controller, so as to be independent of external source, is operated by a spring pilot motor, consisting of a spiral spring, so arranged, that it tends to unwind at both ends. A small electric motor is provided to wind up automatically the spring, the expansion of which controls the starting switch of this motor. Ratchet gearing is arranged to prevent the motor from affecting the movement of the controlling-cylinder. The cylinder is driven by means of an arm and pinion gearing with wheels. The direction of motion is determined by a governing-device mounted in a frame and comprising a pair of electro-magnets with an oscillating polarised armature, a solenoid and a special interlocking and escape gear. One or other of the wheels is locked, and the other left free to rotate when a momentary current is sent by moving the handle. The connections are preferably so arranged that movement in one direction completes a power circuit, and in the other brake circuits. The brakes are operated by the current produced by the motors running as generators. The master reversing-switch controls the motor reversing-switch. Mounted within the casing is a suitably-driven gear-wheel with which engages a pinion arranged to drive a star-wheel or escapement. The pivoted lever is forced down by a roller, and engages with one or other of the levers according to the position of the armature. The gear-wheel is stopped by a roller on an arm controlled by an electro-magnet and a stud controls the star-wheel. A storage battery supplies the currents for the controllers so that they may be operated when the main supply is cut off. 43 claims.

21,657. "Improvements in electric train control systems." The British Thomson-Houston Company, Limited. (C. E. Barry.) Dated October 30th, 1899. Relates to master controller systems for electrically-propelled trains in which the motor controllers are operated by a pilot motor. A throttle shown as a solenoid and plunger switch is used to cut off the current to the pilot motor, when it has reached the desired position, but this throttle is short-circuited by contacts on the motor controller, so that it cannot act unless that controller is in the desired position. The throttle is wound with two coils, one in series with the main motors so as to stop the controller if those motors are receiving too much current, and the other directly supplied through the master controller which is of the resistance and regulating type, so that the speed of the pilot motor may be controlled. An electro-magnetic brake is used, instead of ratchet or similar gear, to hold the motor controller in the desired position. The plunger switches are used to complete and reverse the pilot motor circuits. To prevent damage to the motors if the controller is in the full multiple position after a temporary cessation of current, a switch is introduced to render it impossible to throw on the current until the controller has been returned to its off position. 9 claims.

21,658. "Improvements in signal systems for electric railways." The British Thomson-Houston Company, Limited. (S. B. Stewart.) Dated October 30th, 1899. Relates to electric railways on a sectional conductor system, with electromagnetic switches, and more especially to signalling mechanism for indicating whether or not the sectional contacts are "alive." This specification is too complicated for purposes of abridgment. 6 claims.

21,659. "Improvements in circuit breakers for alternating electric currents." The British Thomson-Houston Company, Limited. (T. J. Johnston.) Dated October 30th, 1899. In order to reduce inductive resistance in the series coil of an alternating current cut-out, a closed circuited coil is employed instead of an armature or core. A closed coil is held down by a spring and connected with trip mechanism. 4 claims.

21,660. "Improvements in electric circuit breakers." The British Thomson-Houston Company, Limited. (H. W. Buoh.) Dated October 30th, 1899. Relates to means for minimising arcing in switches, cut-outs, &c. The terminals or points of contact are completely immersed in a body of glycerine or a non-carbonising hydro-carbon. The carbon should be embedded in a moisture-proof receptacle, or it should be covered with an oil or the like. 5 claims.